GEORGIA INSTITUTE OF TECHNOLOGY
OFFICE OF CONTRACT ADMINISTRATION
SPONSORED PROJECT INITIATION

Date: January 24, 1978

Project Title: Coating Systems for Painting Old and New Structural Steel

U.D

Project No: A-2092

Project Director: D. J. O'Neil

Sponsor: National Academy of Sciences

Agreement Period: From 1/1/78 Until ~~3/31/80~~ 12/31/81

Type Agreement: Contract No. 4-14

Amount: $149,231

Reports Required: Monthly Progress Schedule; Quarterly Narrative; Final Technical.

Sponsor Contact Person (s):

Technical Matters

Mr. Ronald R. Wiley
National Academy of Sciences
2101 Constitution Ave., N.W.
Washington, D.C. 20418
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Contractual Matters
(thru OCA)

Defense Priority Rating:

Assigned to: Technology & Development Laboratory (School/Laboratory)

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CA—3 (3/76)

GEORGIA INSTITUTE OF TECHNOLOGY OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION SHEET

Date 6/4/82

Project Title: Coating Systems for Painting Old and New Structural Steel

Project No: A-2092

Project Director: Dr. C. J. Ray

Sponsor: National Academy of Sciences

Effective Termination Date: 12/31/81

Clearance of Accounting Charges: _____

Grant/Contract Closeout Actions Remaining:

as of this date there is no final

no final report required 6/16 per Linda C.

- [x] Final Invoice and Closing Documents
- [ ] Final Fiscal Report
- [ ] Final Report of Inventions
- [ ] Govt. Property Inventory & Related Certificate
- [ ] Classified Material Certificate
- [ ] Other _____

Assigned to: EMSL (~~School~~/Laboratory)

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FORM OCA 10:781

NCHRP 4-14, FY 1978

WORKING PLAN

COATING SYSTEMS FOR PAINTING OLD AND NEW STRUCTURAL STEEL

Dr. Daniel J. O'Neil
Chemical & Material Sciences Division
Technology Development Laboratory
Engineering Experiment Station
Georgia Institute of Technology
Atlanta, Georgia 30332

January, 1978

Foreward

This document is a "Working Plan", an expansion and amplification of the Approved Research Plan for NCHRP 4-14, as outlined in the original proposal submitted by the Georgia Tech Research Institute on behalf of the Engineering Experiment Station, Georgia Institute of Technology.

Any elements of this Working Plan, which conflict with the research plan of the original proposal, will take preference. This Working Plan will be used in conjunction with the Approved Research Plan of the original proposal, upon approval of the NCHRP 4-14 Review Panel.

Daniel J. O'Neil
Principal Investigator

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

HRP Project No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL Fy' 78 Month _____
search Agency Georgia Tech Research Institute (Engineering Experiment Station)
ncipal Investigator Dr. Daniel J. O'Neil (Telephone: 404-894-3095)

ESEARCH HASES	1978 J	F	M	A	M	J	J	A	S	O	N	D	1979 J	F	M	A	M	J	J	A	S	O	N	D	ESTIMATED % COMPLETION
Current Practices	10	20	40	60	80	90	100																		
sks 1.1-1.4																									
sk 1.5																									
Exptl. Evaln.						5	10	20	30	40	50	60	65	70	75	80	85	90	95	100					
sks 2.1-2.2																									
sks 2.3-2.4																									
sk 2.5																									
idelines													10	20	40	60	80	90	100						
Field Program																	10	25	50	75	100				
iorities																			10	20	40	80	100		
nal Report	-1980- 40	90	100																						
ERALL % MPLETION	3	6	12	18	24	28	33	36	39	42	45	48	50	53	57	62	68	74	77	85	89	92	94	95	
	97	99	100																						

FIG. A—OVERALL PROJECT SCHEDULE

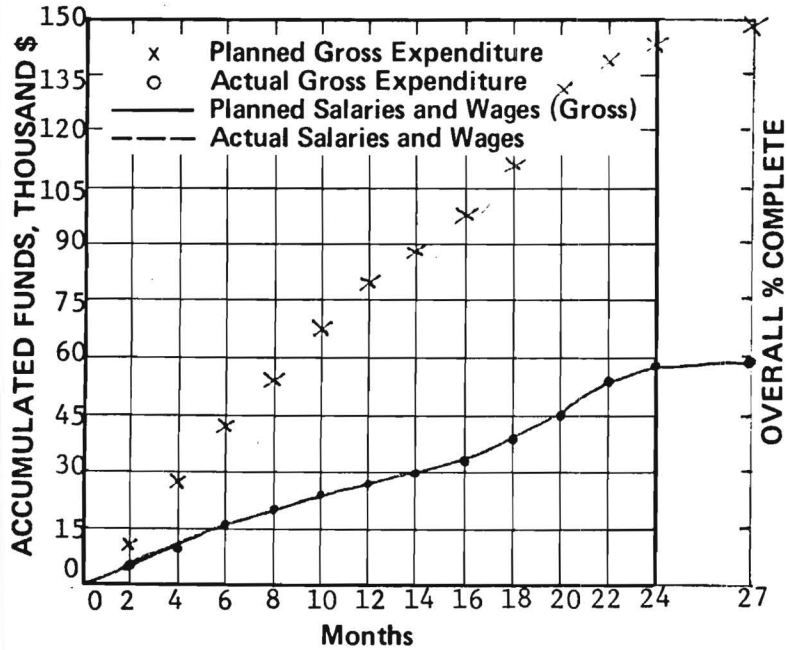

FIG. B—CONTRACT FUNDS

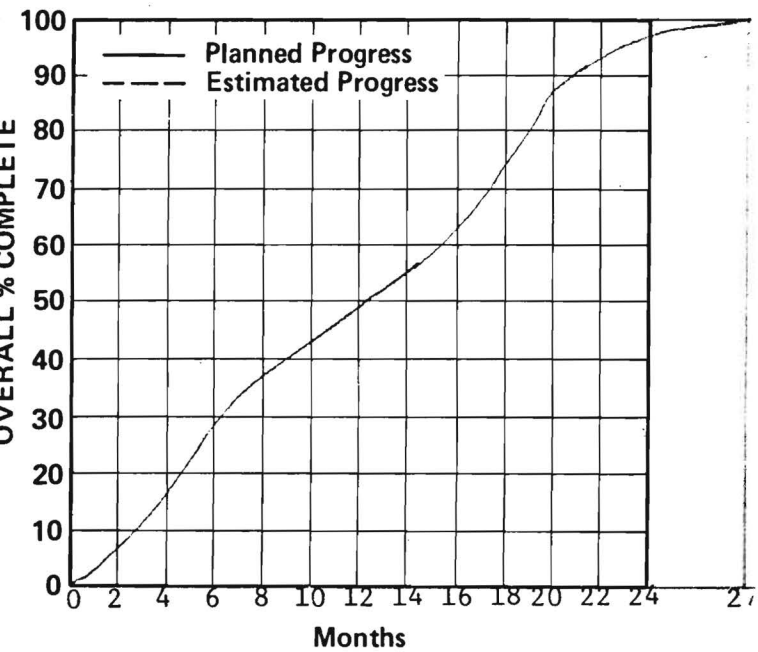

FIG. C—CONTRACT PERIOD

Funds Expended %_____
Contract Amount $ 149,231
Expended this Month $_____
Total Exp. To Date $_____
Balance $_____

Time Expended %_____
Starting Date January 1, 1978
Completion Date March 31, 1980

Salaries and Wages Estimated This Month $_____
Salaries and Wages Spent This Month $_____
Accumulated Salaries and Wages To Date $_____

CONTENTS

Expansion and Amplification of Approved Research Plan

WORKING PLAN

Narrative

Expansion and Amplification of Approved Research Plan

This plan has been developed on the basis of the original research plan (Section 1.2, Research Approach, pp. 7-18) of the original proposal, on the response of August 17, 1977 (letter to K. W. Henderson, Jr., from Mark C. Kelly, Contracting Officer of Georgia Tech Research Institute), and on a discussion held with Mr. Harry A. Smith, Project Engineer, NCHRP staff at Georgia Institute of Technology on October 5, 1977.

1.0 Research Plan

1.1 Objective

The objective of this research is the preparation of tentative guidelines for the use of existing and recently developed nonproprietary coating systems for the painting of structural steel, with emphasis on such considerations as: (a) health and environment, (b) exposure conditions, (c) application requirements, and (d) economics.

In this project, emphasis on health and environment will recognize California's Rule 66 type of solvent restrictions, together with OSHA and EPA regulations as they exist during the term of this research program, with a best guess of pertinent regulations to be anticipated by 1980. Consequently, prime consideration will be given to water-borne coatings containing the least amount of volatile organic constituents. For example, based upon recent findings on methyl n-butyl ketone and 2-nitroparaffin, these solvents will be avoided as far as possible. The choice of all ingredients including pigments and modifiers will be considered for their protective effectiveness versus the latest knowledge and planned regulations on their effect on health and environment. Results of the PACE program, among others, will be monitored.

We propose to consider highway structure exposure conditions using the "zone classification" system (Table 3, p. 11) defined in NCHRP Report 74, "Protective Coatings for Highway Structural Steel," 1969, by J. D. Keane of the Steel Structures Painting Council. All "zones" will be considered in developing tentative coating system guidelines, but the experimental elements of the research will focus on zones 1B and 2B primarily.

Application requirements are not expected to change much from those in general use today, except that it is recognized that spray and roller coating are increasing in economic favor over brushing. Also, water-borne coatings, which might be favored, tend to apply better by spray and roller. In agreement with the NCHRP panel, it is important to investigate the increased use of precoated steel and precoated assemblies. This practice and the types of shop coatings will be documented. New shop coatings will be evaluated for performance "after erection", particularly with regard to the compatibility of shop coats with proposed maintenance coatings. The economic value of completing the entire application of the coating system in one positioning of the staging and other rigging will be considered.

Special conditions will be investigated, e.g., as to variability in the substrate. Welding of weather-treated steel involves a different welding material from that of the weathered steel. Failure in maintenance produces weathered steel streaking of steel below and staining of concrete. The nature of coatings, thickness, etc. for application must be considered vis-a-vis substrate, e.g., hot-dipped galvanized vs. weather-treated steel. Recoating in the field must be assessed in terms of substrate condition, e.g., failure in galvanizing produces unprotected spots which must be repaired by suitable coatings.

Because of the numerous environmental conditions experienced in the United States, it will be necessary to query state highway departments

through use of a well-developed questionnaire as to their experiences and, also, it will be necessary to solicit copies of relevant state specifications for the coating systems. The latter information will form a part of the final report of this project, probably in the form of an Appendix with a separate summary comparison of the specifications.

Unlike the NCHRP Reports 74, 74A, and 75A, summarizing the investigation of the Structural Steel Painting Council, the investigation and reports of this project will include, "Recoating" of old, i.e., in-service, structural steel, particularly as it is affected by environmental restrictions. Both preparation and application will be considered in terms of environmental, economic, and technical feasibility.

Application requirements include preparation of rusted surfaces. Abrasive blasting is generally recognized as most economical for aggressive environmental exposures and particularly for the more durable chemical coatings. The recent experience of wet-blasting in California and newer cleaning methods, e.g., of off-shore drilling rigs, will be evaluated. New methods include dry-ice pellet blasting and the KUE process, developed in the United Kingdom.

2.0 Statement of Work; 1968-1978 Survey

The research proposed to meet the foregoing objective will be divided into phases and subdivided into tasks, as described in the following sections.

PHASE I--Evaluation of Current Practices and Experience

The research program will begin with evaluation of current practices and experience of public agencies, industry and others involved in the protection of structural steel (both new and existing), with regard to such factors as surface preparation, coating systems, coating thickness and exposure. It will focus on developments since 1968, the last year covered by NCHRP Reports 74, 74A, and 74B. This phase would be organized

into tasks as follows.

Task 1.1--Literature Survey

A thorough search of the literature will be made to include as far as possible all published information on recently developed paint systems. Entries into the search would be made from such primary keywords as the following: Coatings; Systems, coating; Paints; Systems, paint; Coatings, steel, structural; etc. Secondary entries would include such terms as: Protective; Corrosion, protective; Corrosion, preventive; Anti-corrosion; Rust resistant; Corrosion inhibiting; Rust inhibiting; etc.

Some sources are computerized and will provide printouts in response to submitted keywords and keyword combinations. Among those available to us are HRIS, NITS, NASA/SCAN, Chemical Abstracts, etc.

Other abstracts which would be useful include: Metal Abstracts, Paint Abstracts, Corrosion Abstracts, etc. In addition, annual indexes of such journals as Paint Journal, Metal Finishing, Steel, Stahl N. Eisen, etc., will be valuable sources of information.

Task 1.2--Contacts with Public Agencies

Among the federal agencies which would be expected to provide information pertinent to our research would be DOT/FHWA, HRB, NCHRP, National Bureau of Standards, Naval Research Laboratory, Army's Construction Engineering Research Laboratory (CERL), Bureau of Reclamation, TVA,
Of significant importance will be close communication and cooperation with the Federally Coordinated Program dealing with corrosion protection of structural steel which is in planning by the Federal Highway Administration (FHWA).

A major initial task will be to develop a "questionnaire" to be sent to state highway departments in order to solicit information as to their current operating practices, specifications, and information on their

current operating practices, specifications, and information on their experience with respect to the special environmental conditions and restrictions existing in their states.

The questionnaire will be designed to anticipate questions of both materials engineers and maintenance engineers. It will be designed to facilitate rapid, detailed response in as time-conservative a manner as possible. A chart-type format which allows selection of "common" answers and/or selective commentary will be used.

It will be aimed at identifying environmental conditions, preferred and non-preferred pre-coated materials, coating materials, re-coating materials, surface preparation techniques. Information regarding special conditions, e.g., painting welds, coating pre-coated structures, etc. will be solicited. Benefits and disadvantages in terms of service life, cost, compatibility, etc. will be analyzed.

Personal visits will be made to appropriate state agencies when availability of detailed information and practical examples warrant close attention.

Task 1.3--Contacts with Private Industry

Many companies in the private sector are engaged in paint related activities; many have their own research laboratories which are engaged in studies closely allied to the proposed research. It is expected that cooperation will be forthcoming from these to provide us with information on specific formulations with which they are directly concerned. Several companies have already agreed to support our activity. Among those from whom such cooperation is expected are the following: Sherwin-Williams, Glidden, Dupont, Carboline, Reliance, Porter Paint, PPG and Napko. Paint raw materials suppliers, such as Union Carbide, NL Industries, Rohm & Haas, Polyvinyl Chemical, Pfizer, Hammond Industries, Southern Services, Mobil Oil and Exxon.

Task 1.4--Contacts with Other Laboratories

There are many other laboratories engaged in coatings research and in related topics such as polymers, surface chemistry, corrosion, etc. Some are connected to universities, while some are privately operated. These laboratories may generally be identified via reports in the published literature. Where a mutually beneficial exchange of information can be offered, as would be the case in this instance, such an exchange can generally be arranged without difficulty. The support of the Structural Steel Painting Council has been arranged. The NASA Technology Application Team at Stanford Research Institute and the American Railway Engineering Association have offered their services, as well. ASTM and NACE will be contacted.

Task 1.5--State-of-the-Art Report

Information gathered from the sources identified in Tasks 1.1 to 1.4 will be analyzed and summarized in the form of a state-of-the-art report designed to up-date NCHRP Reports 74, 74A, and 74B. It will identify vehicles, solvents, and pigments; methods of application; identity and condition of substrates; times of application; times of inspection: preparation and application parameters: costs; environmental factors: cumulative results. Recommended systems, and alternates, for painting and repainting steel under defined "zoned" categories will be developed. Standard controls for the experimental tasks of Phase 2 will be recommended.

Twenty copies of the draft report and recommendations will be submitted to NCHRP Panel 4-14 for review, evaluation and approval.

PHASE 2--Experimental Evaluation of Recently Developed Systems

Task 2.1--Review of Phase 1

At the outset of Phase 2, which is experimental in nature, rather than informational, Phase 1 will be reviewed in its entirety for the purpose of assuring that the selection of formulations, materials, test

procedures, etc., will be most productive in meeting the objective of the proposed research. It will be an objective to establish acceptable standard controls and candidate formulations for experimental verification studies.

Task 2.2--Selection of Candidate Formulations

While the ultimate selection of candidate formulations will depend upon the information accumulated, compiled and correlated in Phase 1, it is anticipated that the systems from which experimental formulations will be selected are the following:

I. Primarily Heavy-duty Systems:

	Primers	Topcoats
A.	Zinc-rich Primers:	Solutions:
	Alkyl silicate	High-build vinyl solution
	Modified alkyl silicate	Vinyl/acrylic solution
	One-pack alkyl silicate	Latexes:
		Vinyl acetate/acrylic latex
		Acrylic latex
		Styrene/acrylic latex
		Acrylic/vinyl chloride latex
		Acrylic/ethylene latex
		Emulsions:
		Water-borne epoxy amine
B.	Polymeric*	
	Vinyl solution	High-build vinyl solution
	Vinyl solution	Vinyl alkyd solution
	Isophthalic alkyd	Isophthalic alkyd

II. Primarily Rural

C.	Latexes*:	Latexes:
	Vinyl acetate/acrylic	Vinyl acetate/acrylic

Acrylic	Acrylic
Styrene/acrylic	Styrene/acrylic
Acrylic/vinyl chloride	Acrylic/vinyl chloride
Acrylic/ethylene	Acrylic/ethylene

D. Water-borne Oil-free Polyesters*:

such as based on:

Esterdiol 204	same
Water-borne epoxy amine	same

E. Controls (as determined from Phase 1)

It is intended to evaluate non-proprietary coating systems, both existing and recently developed systems. The experimental phase of the program, however, will concentrate on recently developed coating systems for which little or no data exists. Non-proprietary systems is meant to define formulations which are available from more than a single source. Such systems should be defined by specifications which allow formulation by more than one paint manufacturer. If appropriate, certain currently "developmental" systems might be included in the study if there is evidence that they will be non-proprietary, by the above definition, upon commercialization.

Newer systems which are designed to meet environmental standards include the following:

(1) Formulations of water-based systems which are equal to or better than alkyd systems. Development of water-based primers (California study under HPR).

(2) High-solids coatings.

(3) New solvents--alternatives. Acceptability in the long-term must be considered, e.g., methylisobutyl ketone was replaced by methyl n-butyl ketone, which was subsequently banned, in turn.

Task 2.3--Preparation of Test Formulations

As quickly as the formulations to be included in the experimental program are selected, the raw materials will be placed on order. As the materials are received, the formulations will be prepared in the laboratory in quantities of sufficient size to accommodate the test program and to provide accuracy in measurement and mixing of the ingredients. The formulations will be stored in friction-seal cans labeled as to formulation number, date of preparation and such other information as shall be pertinent.

Task 2.4--Testing Program

Testing will be done on substrates characteristic of structural steel and specifically for the purpose of comparing corrosion resistance of the various systems. For this reason, rather than utilize Q-panels of cold rolled steel, we shall utilize KTA panels. Constructed of plate and channel forms, the KTA Test Panel includes all common surface characteristics that promote early paint failure: corners, edges, scratches, impact injury, welds, inside angles and moisture pockets.

In agreement with the comments of the NCHRP panel and following discussion with Mr. Smith of the NCHRP, the testing program will be defined to limit accelerated testing with the objective of generating useful service information after about one year of exposure.

The number of systems to be investigated is undeterminable until the results of Phase 1 are produced. However, within best estimates currently determined, it is anticipated that a maximum of 180 test panels could be required. This estimate was initially based on a statistically-designed experiment in which up to seven surface treatments, up to eight topcoats, up to twelve primers, three levels of thickness, and two levels (natural and accelerated) of exposure would be investigated. This level of activity could be too optimistic. With the agreement of the NCHRP 4-14 Panel, a revised

plan would be submitted near the conclusion of Phase 1. For example, two levels of thickness (5 and 10 mils) might be used, rather than three, and the applications in the coastal environment might be limited to 10 mils. In this manner an increase in the number of systems, above the numbers anticipated for study, could be accommodated. It is anticipated that by the use of these panels comparative performance of the various systems will be more quickly evaluated than by any other means.

Surface preparation of the panels will include the following:

Near white metal sand blast

Good commercial blast

Hydroblast

Wet sand blast

Wet grit blast

Brush blast to clean old painted surfaces

Hydroblast to clean old painted surfaces

Coatings will be applied in thickness of approximately 5 and 10 mils, utilizing minimum thickness of primer and topcoat as follows:

Nominal thickness (mils)	Primer (mils, minimum)	Topcoat (mils, minimum)
5	1½ to 2½	3½
10	1½ to 3	8½

Exposures will include the following:

A) Natural Exposure: 45° South for a period up to one year in a coastal environment located in Burnswick, Georgia. The site has been made available for this study by the Georgia Department of Transportation.

B) Accelerated Exposure: Weatherometer for up to 1,000 hours

Salt spray up to 3,000 hours, 5% and 100°F

Following exposure, inspection and evaluation will be conducted in accordance with principles and procedures related in the Steel Structures Painting Manual, Volume 1, Good Painting Practice.

Should the inspection disclose special problems with respect to the integrity of the paint film or its mechanical properties, difficulties with application or adhesion of the paint to the substrate, indications of corrosion phenomena, such as stress corrosion, which might accentuate the corrosion damage, or other problems of diverse nature, such problems will be given special attention in one or more of the laboratories listed in the original proposal under Section 5, Equipment and Facilities.

Task 2.5--Compilation of Results

The experimental evaluation of the systems selected for application and examination will be concluded by a thorough compilation of the results, utilizing appropriate statistical procedures to develop correlations among the various parameters of surface preparation, application technique, primer and topcoat composition, exposure type and exposure duration.

It is hoped that the test panels located on the coastal site in Brunswick, Georgia will be monitored beyond the time frame of this contract by the Georgia Department of Transportation, FHWA, or other investigators in order to maximize the benefits of the field tests and to provide data for correlation to the accelerated weathering tests performed in our laboratories.

PHASE 3--Preparation of Tentative Guidelines

Task 3.1--Review of Guidelines for Coating of Structural Steel, Present Technology

It is not the intention of this phase of the research to generate a new series of specifications since such standards have been developed by the National Association of Corrosion Engineers, AASHTO, SSPC and the ASTM--many of which are cross-referenced. ASTM, in particular, has specifications

for most of the raw materials. These sources will be used to develop the tentative guidelines of this phase of the study.

The Steel Structures Painting Manual, Volume 2, Systems and Specifications, Second Edition, 1967, is representative of the present technology for the formulation of primers and topcoats for the corrosion protection of steel structures. Many of the formulations included in this manual have been utilized on steel structures during the past decade, and it is anticipated that a number of the reports in the literature in Phase 1, Task 1.1, will include field tests conducted with these formulations. The results reported on such tests will be compared with results obtained on newer formulations in Phase 2 of this research, such comparison to include especially the ten desired characteristics listed in Section 1.1.3 (p. 5) of the original proposal

Task 3.2--Modifications of Guidelines Imposed by New Systems

In all instances in which the newer formulations produce factors which indicate superiority over present formulations, modifications in the present guidelines will be made to bring them into conformance with the use of the newer formulations.

While the prime purpose of the research is the development of tentative new guidelines for the formulation of paints, the performance of those included in the Phase 2 program will be governed, in part at least, also by the methods of surface preparation and paint application utilized. These factors will, then, be reflected in the results obtained in Phase 2 and the modifications imposed upon present guidelines in this task. In short, new guidelines may apply primarily to formulations, but will imply certain modes of preparation and application, as well.

Task 3.3--Final Version of Tentative Guidelines

While some of the present guidelines will be modified by Phase 2 results, others will remain unchallenged. The final tentative guidelines will

consist, therefore, of some new or modified versions of present guidelines, some which will remain in question as to whether modifications are fully justified, and some which will remain unchanged.

PHASE 4--Design of a Field Evaluation Program

Task 4.1--Review of Present and Past Field Evaluation Programs, with Critique

It is anticipated that the literature survey of Phase 1, Task 1.1, will have included reports of field evaluations conducted in recent years. These will be reviewed critically to determine the extent to which they fulfilled their intended purposes and to identify whatever faults induced failure to meet those purposes. The results of this review will be summarized in terms of objectives, procedures, results and conclusions of each such evaluation program, with an overall summary of all those reviewed.

Task 4.2--Objectives of Field Evaluation

A field evaluation must obviously have the objective of providing long-term in-service data on the performance of each system, together with the effects of surface preparation, method of application and environmental factors. For each individual field evaluation program, however, it is often desirable to concentrate on certain factors more than others. For this reason, each field evaluation program will be directed toward a somewhat different set of objectives. The decision as to what are the specific objectives for the field evaluation program to be derived at this point, is a decision which must be made before that program can be defined.

Task 4.3--Final Version of Field Evaluation Program

Once the objectives have been established, on the basis of results obtained in Phase 3 and review of previous field evaluation programs in Phase 4, the necessary ingredients of a field evaluation can be assembled. This program would carry the experience of the Phase 2 experimental program into the area of practical service application on a full-scale structure,

wherein quantities of materials used, areas covered, types of surface, types of application and types of exposure would realistically parallel those to be encountered by a paint system accepted for full-time service.

PHASE 5-- Priorities for Needed Research

Task 5.1--Review of Laboratory and Field Evaluations

A critical review will be made at this time of the work to date, with special attention given to: (a) the laboratory evaluation program and its results, and, (b) the design of the field evaluation program. A prime purpose of this examination will be the identification of data gaps; i.e., promising systems for which present research data are incomplete or inconclusive.

Task 5.2--Identification of Problems and Problem Areas

The preceding review will provide the basis for identification and assessment of major problems in the proposed tentative guidelines. These problems will be categorized as requiring further research in one or more of the following areas:

Formulation procedures
Materials selection
Substrate treatment
Application techniques

} To bring steel structures painting systems into closer conformance with desired characteristics stated in Section 1.1.3 of the original proposal.

It is apparent that the present proposed research is for an initial effort, only, and that this effort will need to be followed by an intensive and extensive research effort across a broad field of chemical formulations and materials, as well as preparation techniques and application procedures. Such research effort would have a goal of bringing the technology of steel structures painting to its highest attainable peak, one which would see coatings with double decade durability even in very aggressive environments.

At this point it is not possible to predict what the elements of such

a research program will be, but with the background of Phases 1 through 5 of this research project, followed by the review and problem identification efforts of Tasks 5.1 and 5.2, it is believe that the problems which must be addressed in subsequent research will be clearly defined. Some of these problems will be of such urgency that their early solution would have considerable impact upon steel structures painting practices. Such problems should be given the highest possible priority for subsequent research. Other problems will be of lesser, some of even negligible, impact. These would obviously be assigned lower priorities.

The assignment of priorities for subsequent research will, then, be a major product of this initial research effort and constitute the closing activity of the proposed research.

A-2092

QUARTERLY PROGRESS REPORT

to the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

on Project

NCHRP 4-14 FY '78

Coating Systems For Painting Old and New Structural Steel

for period

January 1, 1978 to March 31, 1978

from

Georgia Institute of Technology, Engineering Experiment Station

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

RP Project No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL Fy' 78 Month March '78
rch Agency Georgia Tech Research Institute (Engineering Experiment Station
ipal Investigator Dr. Daniel J. O'Neil (Telephone: 404-894-3095)

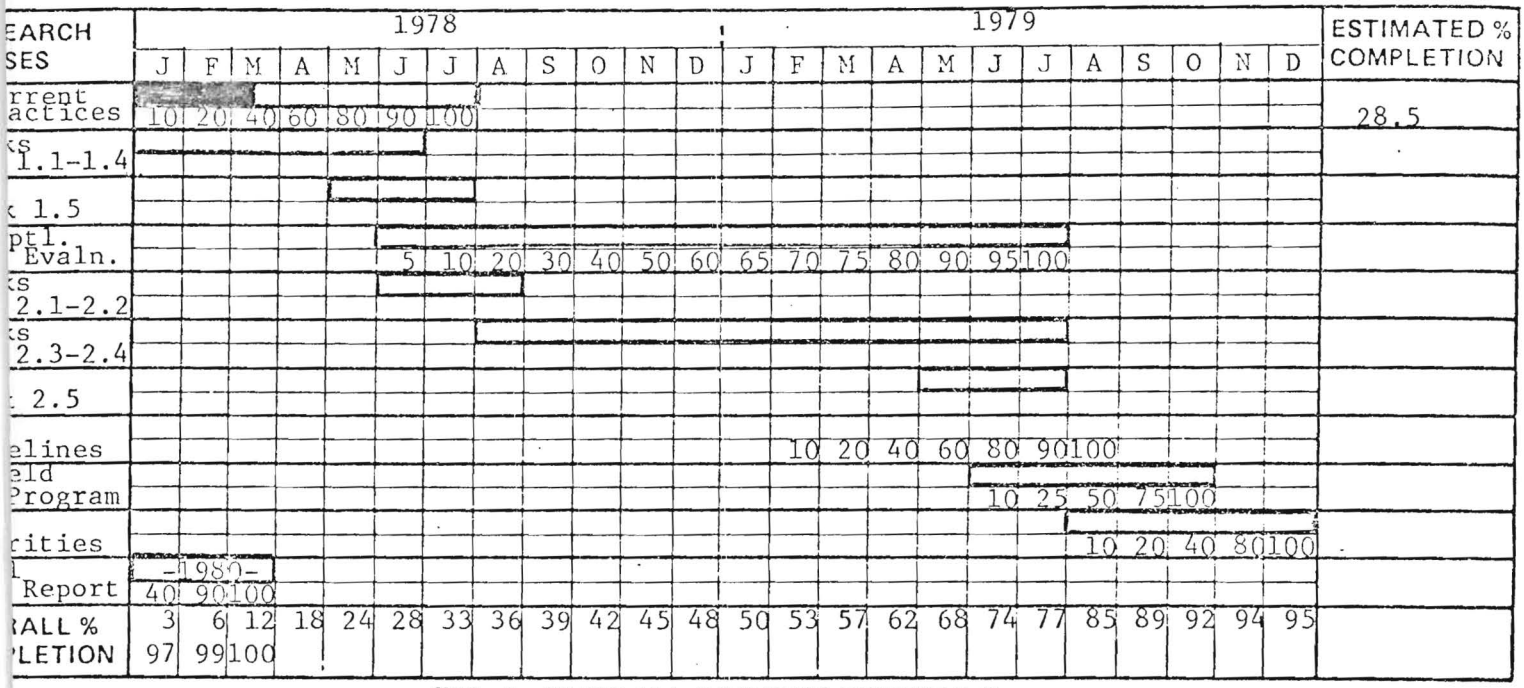

FIG. A—OVERALL PROJECT SCHEDULE

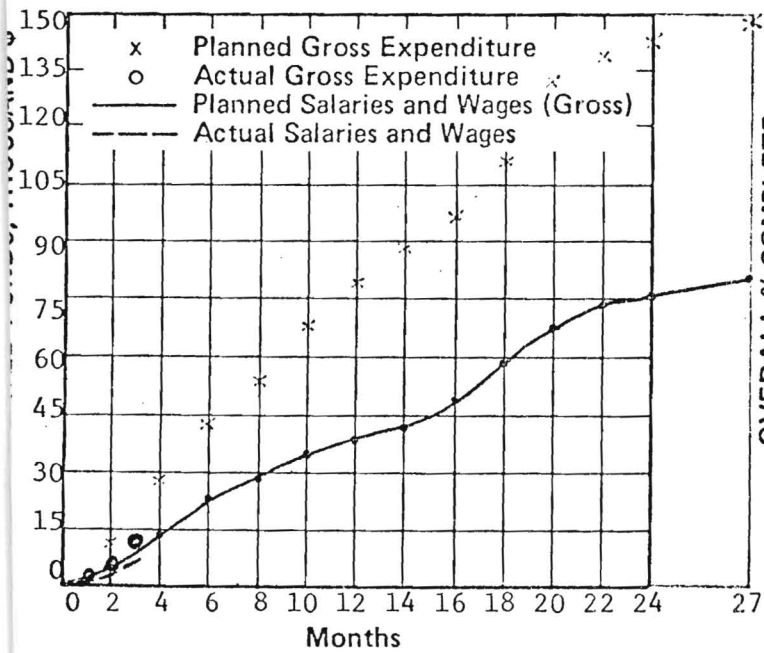

FIG. B—CONTRACT FUNDS

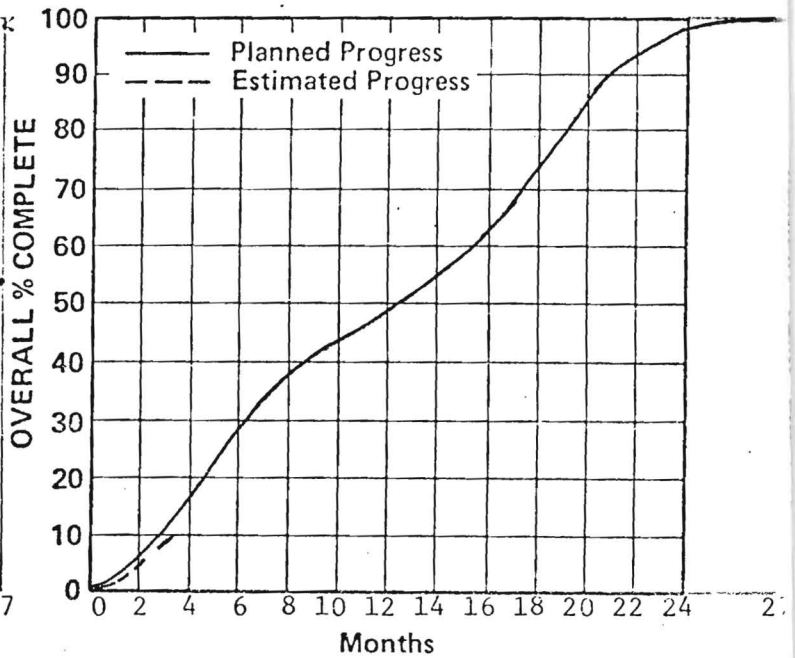

FIG. C—CONTRACT PERIOD

Funds Expended	%	8.5
Contract Amount	$	149,231
Expended this Month	$	6,561
Total Exp. To Date	$	12,660
Balance	$	136,571

Time Expended %	8.6
Starting Date	January 1, 1978
Completion Date	March 31, 1980

Salaries and Wages Estimated This Month	$	4815
Salaries and Wages Spent This Month	$	3426
Accumulated Salaries and Wages To Date	$	6835

NCHRP 4-14, FY 1978

COATING SYSTEMS FOR PAINTING OLD AND NEW STRUCTURAL STEEL

First Quarterly Report: January 1, 1978 - March 31, 1978

Submitted by: Dr. Daniel J. O'Neil (Principal Investigator)
Chief, Chemical and Material Sciences Division
Technology and Development Laboratory
Engineering Experiment Station
Georgia Institute of Technology
Atlanta, Georgia 30332

March, 1978

I. Introduction

All state and local highway agencies have steel structures that must be painted to provide protection against corrosion. Available funds dictate the number of structures that can be painted and the grade of surface preparation that can be used.

Although various coating systems intended to protect structural steel are available, users report a wide range of results. Many systems, including those in general use, require a degree of surface preparation and use of solvents, both in the formulation and for cleanup, that are being increasingly restricted to protect health and environment. In addition, some systems have poor flow characteristics, require a high degree of surface preparation, and require highly skilled applicators.

The objective of this research is the preparation of tentative guidelines for the use of existing and recently developed nonproprietary coating systems for the painting of structural steel with emphasis on such consideration as (a) health and environment, (b) exposure conditions, (c) application requirements, and (d) economics. It is anticipated that accomplishment of this objective will involve:

1. Evaluation of current practices and experience of public agencies, industry, and others involved in the protection of structural steel (both new and existing) with regard to such factors as surface preparation, coating systems, coating thickness, and exposure.

2. Selection and experimental evaluation of recently developed coating systems for structural steel. The experimental program is intended to be an accelerated test that is expected to provide useful information after about one year of exposure.

3. Preparation of tentative guidelines for the selection and application of coating systems for defined sets of conditions based on current experience and limited experimental evaluation work.

4. Design of a field evaluation program for selected coating systems compatible with the project objective. The field evaluation design should consider the practicality as well as the performance of the selected systems.

5. Determination of gaps in the tentative guidelines and recommendation of priorties for needed research.

II. Research Activities: January 1, 1978 - March 31, 1978

The research activities of the first quarter have been concerned exclusively with elements of Phase I, "Evaluation of Current Practices and Experience" of the Work Plan. More specifically, work has been initiated on Tasks 1.1 through 1.4.

Before commentary on a description of the work undertaken on each individual task it is well to outline the strategy which has been adopted to insure completion, successfully, of Phase I.

Firstly, a literature survey has been initiated. Besides providing the basis for a state-of-the-art report (Task 1.5), the survey is generating information regarding the identification of organizations which are active or have been active in the investigation of coatings for steel structures. These organizations, and the individual investigators particularly, are being contacted (per Task 1.2 through 1.4). This procedure will allow the project team to identify the researchers and users most active with (most) current practices and experience.

Secondly, based on an extensive list of contacts in the paints and coatings industry, we have solicited general information, via a standard letter of inquiry (see Appendix A), on the coating of old and new structural steel. Direct contact with individuals at a recent meeting and by telephone has been and is being used to elicit a meaningful level of response from industry. Based on the generalized responses from this sector, a refined and formalized questionnaire is being drafted for submission to state highway departments and DOT's to determine hard, experimental data on the coating of old and new structural steel.

The questionnaire will be submitted to the industrial sector respondents (and non-respondents) to the initial letter of inquiry to obtain more detailed information. It will also be used with public agencies (other than the state DOT's) and with the other laboratories (previously indentified) who have been recently active in the field of steel coatings.

Task 1.1 Literature Survey

Computerized information retrieval has been undertaken using the data bases of the Transportation Research Information Services (TRIS), the National Technical Information Services (NTIS), the machine-readable version of the Engineering Index (COMPENDEX), of the Metals Abstracts/ Alloys Index (METADEX), Chemical Abstracts (CA CONDENSATES and CA CONDENSATES/CASIS), and Current Awareness because of its minimal cost, through the Georgia Information Dissemination Center.

Our initial computer retrieval program has been modified to reduce the volume of printouts (which includes title, author, organization, sponsoring agency, keywords, abstract, etc) to a manageable level. The

print-out format has been selected to present the organization, address, and name of the report author(s) firstly, thus facilitating future contact with the investigators.

Where data bases extend back to reports or articles issued or printed in 1968, titles and abstracts for the period 1968 - present are being retrieved.

Refinement of our computer program was necessary to reduce the available number of reports and articles from numbers in the "thousands", relating "steel" and "coatings", to manipulative numbers. First results follows:

Database	Number of Articles
NTIS	29
COMPENDEX	134
METADEX	197
TRIS (incl. HRIS)	108

It was found that employing the keywords "recoating" or "repainting" (on the NTIS data base) that no articles were retrievable.

World Surface Coatings Abstracts has been surveyed for the last two years.

Task 1.2. Contacts with Public Agencies

The "questionnaire" to be submitted to public agencies, in particular the state highway departments and departments of transportation, has been drafted in very preliminary form. The responses to our inquiries from industry (see Task 1.3.) will influence the final draft version of the questionnaire. It is expected that input from the Federal Highway Administration will be important to the design of the questionnaire. This

point was discussed with Dr. Bernard Appleman in March and the interest in FHWA cooperation was confirmed.

The Georgia Department of Transportation (Office of Materials and Research: Hugh Tyner, Director) was notified of the status of NCHRP 4-14. GDOT has agreed to allow us the use of selected panels (KTA and flat-type) which formed a part of a previous GDOT-Georgia Tech study on coating of highway steel structures. This will facilitate the study of coating (recoating) of old structural steel as part of the project under Phase 2. We confirmed that the Brunswick site will be available for an outdoor exposure test. With GDOT personnel we are identifying and selecting on a preliminary basis those panels for use in Phase 2. The panels are located at two test sites: one on our campus, and the second in Brunswick. Original applications were made as early as 1965. Mr Ray Tooke who was involved in the original study was contacted and he provided background information on the panels.

In correspondence with the NCHRP 4-14, we have suggested that the most appropriate individual in state DOT's might be identified by the FHWA regional offices who might also act to distribute the questionnaire. Meanwhile, individuals have been identified from the AASHTO membership directory who appear to hold state positions responsible for the evaluation, application, or specifications of coatings for structural steel.

Task 1.3. Contacts with Private Industry

In order to accelerate the development of the questionnaire to be submitted to state highway departments and state DOT's, and to generate information from the industrial sector on coating systems which fulfill the

objectives of this project (see Introduction), a standard letter of inquiry (Appendix A) was sent to major raw material suppliers, paint companies, and equipment suppliers. Feedback from this survey is being used to refine the draft questionnaire.

Industrial firms who are being requested to suggest systems or components to consider for meeting our objectives are listed in Table I.

Sales figures for the firms are listed and represent total sales for latest 12 months as reported by Chemical Week, February 27, 1978 Sales volume as maintenance paint or all paint materials is not usually available. We have shown our rough estimate for comparison.

The major suppliers to the maintenance coatings market are listed first.

Supplying paint against bids for individual bridge coatings is most often the regional paint manufacturer rather than the largest maintenance paint manufacturers who operate nationally. For that reason we have solicited some smaller firms known to be active bidders in the local areas. Most of the larger firms who do intensive development work on coatings formulations for potential end uses or applications try to develop proprietary paints and try to win business with a superior product. This is sometimes called "fine-tuning" of generic coatings types and must not be overlooked for some possible "best answers" to our objectives for cost/performance, environment, application, and exposure conditions.

The initial level of response to our letters of inquiry has not been great. The difficulty has been identified, following telephone

conversations and personal contact by a member of the project team (F.A.R.) with representatives of industry at Corrosion '78, the NACE meeting held in March in Houston. The difficulty is created by the apparent requirement that coating systems be classified as "non-proprietary".

Clarification of this point with industrial representatives has resulted in a commitment by those individuals who were contacted to provide a more detailed response to the letter of inquiry (see Appendix A).

Table I. Surveyed Paint Industry

	MM$ Total Sales	Binder	Pigment	Paint	US Maintenance Paint Sales[E]MM$
Ameron	220E			X	15
Carboline	30E			X	30
DuPont	9435	X	X		160
Gildden	1429	X	X		140
Int'l Paint	15			X	15
Mobil Oil	35,700	X		X	55
Napko	28			X	11
Porter Coatings	37			X	30
PPG Industries	2506	X	X	X	180
Sherwin-Williams		x	x	x	140
Matcote				X	30
Reliance Universal	139	X		X	35
Grow Chemical	187	X		X	70
Koppers	1356	X		X	30
Ashland Chem.	4894	X			
M A Bruder & Sons				X	25
Engard Coatings				X	
Dexter Corp.	316E			X	10
Farboil Corp.				X	
Hercules	1698	X	X		
Hughson Chem	66E			X	5
Mobile Paint Mfg.	20E			X	18

Table I. (Con't)

	MM$ Total Sales	Binder	Pigment	Paint	US Maintenance Paint Sales[E] MM$
Monsanto	4594	X			
Plas-Chem Coatings				X	5
San Jacinto Pt				X	1
Shell Chemical	13,193	X			
Southern Imperial	15E				7
Wisconsin Prot.	25E			X	5
Asarco			X		
American Cyanamid	2410	X	X		
BASF Corp		X	X		
Cargill, Inc.		X			
General Electric		X			
Hammond Lead			X		
Mobay Chemical		X			
NL Industries		X	X	X	
Pfizer, Inc.			X		
Rohm and Haas		X			
Union Carbide		X	X		
U. S. Steel		X			
ICI Chemical Spec.		X			

E-estimated

Five equipment suppliers have also been contacted for their recommendations and new developments as they make changes to meet the changing economy and anticipate regulations concerned with paint application. They are:

1. Binks Mfg. Co., Atlanta, GA
2. Hydrill Co., Houston, TX
3. Nordson Corp., Amherst, OH
4. Graco, Inc., Minneapolis, MINN
5. DeVilbiss Co., Toledo, OH

Our inquiry was also sent to individuals, usually corrosion engineers, in firms known to have a great interest in better protective coating systems.

We have included the firms and addresses of individuals responsible for the technical progress in most of the firms working actively with pertinent committees in ASTM, NACE & SSPC-PACE Committees. These include:

Ashland Petroleum Co., Ashland, KY

Brown & Root, Inc., Houston, TX

Chevron Oil Co., New Orleans, LA

Coastal Galvanizing Co., Friedswood, TX

Metalweld, Inc., Philadelphia, PA

Task 1.4. Contacts with Other Laboratories

As indicated earlier extensive contact with laboratories, such as universities, research institutes, trade association, etc. are being identified through the literature survey. Certain organizations, notably the Steel Structures Painting Council, have offered their support. The SSPC

has been asked to provide an attendance list from their annual meeting and has agreed to do so. NACE Committees, particularly T-6H, members and chairmen have been consulted and cooperation has been provided.

Information on the NASA zinc-rich coating system (NASA Technology Applications Team, Stanford Research Institute) which is undergoing field tests on several coastal bridges and elsewhere is being obtained.

Committee 15, Steel Structures, of the American Railway Engineering Association has been solicited for assistance.

III. Planned Activities: April 1, 1978 - June 30, 1978

During the second quarter, we plan to complete up to 20% of the tasks of Phase 1. This will include development of the draft questionnaire, approval by the NCHRP panel, distribution, retrieval of responses, and critical analysis of the responses. A comparison will be made of manufacturers' claims with the performance experience of users, in particular state highway departments. Selection of promising coatings systems fulfilling the project objectives will be made on a near final basis. Ordering of materials will have been initiated for all possible systems and their components, so that elements of Phase 2, "Experimental Evaluation of Recently Developed Systems" can be initiated.

A draft state-of-the-art report will be completed or near completion for submission, reviews, evaluations, and approval by the NCHRP 4-14 panel.

Appendix A.

Form-Letter of Inquiry to Industry

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

"Coating Systems for Painting Old and New Structural Steel" is the title of a two-year project, recently initiated by Georgia Tech on behalf of the National Cooperative Highway Research Program.

Project Objective

The objective is the preparation of tentative guidelines for the use of existing and recently developed non-proprietary coating systems for the painting of structural steel, with emphasis on such considerations as: (a) health and environment, (b) exposure conditions, (c) application requirements, and (d) economics. We will update and extend the work done by the Steel Structures Painting Council and published by NCHRP in 1969.

Industrial Participation

The results of this research will make considerable impact on the paints and coatings industry. Input from this sector is vital to the conduct of this project and will aid the drafting of guidelines and in the selection of newer systems for expanded testing programs.

Your Opinion and Experience

Please consider the following questions and answer them in as much detail as your time permits--and as soon as is convenient:

(1) What "recently-developed" (roughly 1970 and onwards) non-proprietary coating systems for (a) the painting, or (b) re-coating of painted, structural steel offer the most promise to meet the project objective?

(Note: "Non-proprietary systems" is meant to define formulations which are available from more than one source. Such systems should be defined by specifications which allow formulation by more than one paint manufacturer. If appropriate, certain currently "developmental" systems might be included in the study if there is evidence that they will be non-proprietary, by the above definition, upon commercialization.)

(2) Please provide summaries of your experience or references to the advantages and disadvantages of application of your coatings suggestions in terms of the following factors:

a. surface preparation
b. application
c. thickness
d. cost
e. durability
f. exposure conditions
g. environment and health

(3) Please provide relevant literature which can assist us in implementing this project.

Our question to equipment suppliers is: What's new in surface preparations and spray equipment? Do you have recommendations for applying water-thinned coatings and high solids coatings? Do you have suggestions for viscosity, pressures, nozzels, etc., that may be different from equipment designed for conventional solvent-borne coatings? Field application for old and new structural steel is the objective.

Use of Your Information

Your information will be combined with other responses, (a) to prepare a state-of-the-art report and, (b) to determine a selection of coatings for field evaluation and accelerated testing.

Since we are on a tight schedule, your prompt response to this questionnaire will be appreciated. Please duplicate this questionnaire if there are others in your organization who might care to contribute their opinions.

Thank you very much for your assistance.

Yours sincerely,

Daniel J. O'Neil, Ph.D.
Principal Investigator
(404) 894-3095

Frank A. Rideout
Senior Research Scientist
(404) 894-3375

DJO'N/FAR:bn

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

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Daniel J. O'Neil, Ph.D
Principal Investigator
(404) 894-3095

Frank A. Rideout
Senior Research Scientist
(404) 894-3375

DJO'N/FAR:bn

Appendix B

Trip Report: NACE Conference, Houston, March, 1978

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

March 22, 1978

Mr. Harry A. Smith
Staff Engineer, NCHRP
Transportation Research Board
2101 Constitution Avenue
Washington, D. C. 20418

Project: NCHRP 4-14, FY'78 "Coatings for Old and New Structural Steel"

Re: Trip Report - F. A. Rideout to Corrosion '78

Dear Harry:

I attach a copy of Mr. Rideout's report on his trip to the meeting of the National Association of Corrosion Engineers, Corrosion '78, for the period 7-9 March 1978.

We have concentrated heavily on eliciting information from industry and this conference provided an opportune mechanism for obtaining the views of a wide cross-section of industrial and other specialists on NCHRP 4-14.

I hope that this submission meets NCHRP requirements. If not, we will furnish additional information.

Yours sincerely,

Daniel J. O'Neil
Principal Investigator, NCHRP 4-14
and
Chief, Chemical and Material Sciences Division

DJO'NEIL/gwn

Attachment

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

March 10, 1978

MEMORANDUM

TO: D. J. O'Neil

FROM: F. A. Rideout

RE: NACE Meeting: CORROSION '78, Houston, March 7-9, 1978

FOR: Project-EES A-2092, NCHRP 4-14, "Coatings for Old and New Structural Steel"

HIGHLIGHTS

1. Continuing Surface Preparation Study (T6H15) at six years panel exposure at five severe chemical plant locations for five types of coatings, clearly shows protection is most influenced by method of surface preparation, second by exposure location and least by primer type. Present overall rank is:1)post-cured zinc-rich, 2) self-cured zinc-rich, 3) vinyl, 4) chlorinated rubber, and 5) epoxy. This detailed NACE-funded computer program, as well as the panels themselves are available for our own direct analysis. (Report attached)

2. An NACE Regional meeting in Cleveland October 10-11, 1978 was planned to bring together twelve paint industry specialists to discuss how to comply with Rule 66, California Air Resources Board, OSHA, EPA, FDA and TOSCO by review of coating forms, ingredients, surface preparation, application tools, flammability, etc. Chairman is T. P. Wilhelm of Glidden who has also agreed to give us a detailed reply to our paint supplier inquiry.

3. DuPont, Mobay, and others foresee catalyzed high-build urethanes proving economy ($/ft^2/year of service) and compliance, especially as topcoats over zinc-rich.

OTHER INTERVIEWS

1. Carboline (John Montle-TD, Herb Tarles-V.P., Stan Lapota-Pres.) has replied negatively to our inquiry but has agreed to help now that he understands we do not intend to conclude with composition specs. for bridge coatings.

2. Amercoat (Dan Gelfer-TD) will reply to our inquiry.

3. Napko (Mal Henry-TD) will reply to our inquiry.

4. ICI America (G.G.C. Stepto-Development) will reply to our inquiry.

5. Mobay Chemical Co. (Jack J. Bracco-Dev. Super.) will reply to our inquiry and send report on economic study, overall costs review Golden Gate bridge experience and data on performance over various surface preparations.

6. Asarco (Willard Lance-Mkt. Mgr.) will reply to our inquiry--re: zinc-rich.

7. Porter Coatings (Gary M. Zinn-Mkt. Mgr.) will reply to our inquiry.

8. DuPont (Ed Zinzer-Mkt.Mgr., and Walt Pregnon-Lab. Head) will reply.

9. SSPC (Dr. Joe Bruno) will cooperate, send attendance lists from last annual meeting, PACE, surface preparation and Golden Gate update.

10. Imperial Coatings and Chem. (Tom Bauer-S.M.) was negative to inquiry, but will seek our help for NACE Program in 1979 in Atlanta.

11. Prufcoat (J. W. Rumbolt) will reply and suggest systems.

12. Sherwin-Williams will reply but it may not be Steve Brotzman.

13. (Bill Wallace) feels government regulations will make all systems obsolete except epoxy.

14. Wisconsin Protective Coatings (Walt Singleton) will give some guidelines and material types to study but his company works only with each individual coating job.

15. Fluor Corp. (Al Roebuck) would review our findings and comment but have little new to add now.

The contacts made at the meeting and the copies of relevant investigation will prove invaluable to the performance of NCHRP4-14(A-2092)

FAR/gwn

A-2092

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

P Project No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL Fy' 78 Month April '78
ch Agency Georgia Tech Research Institute (Engineering Experiment Station
pal Investigator Dr. Daniel J. O'Neil (Telephone: 404-894-3095)

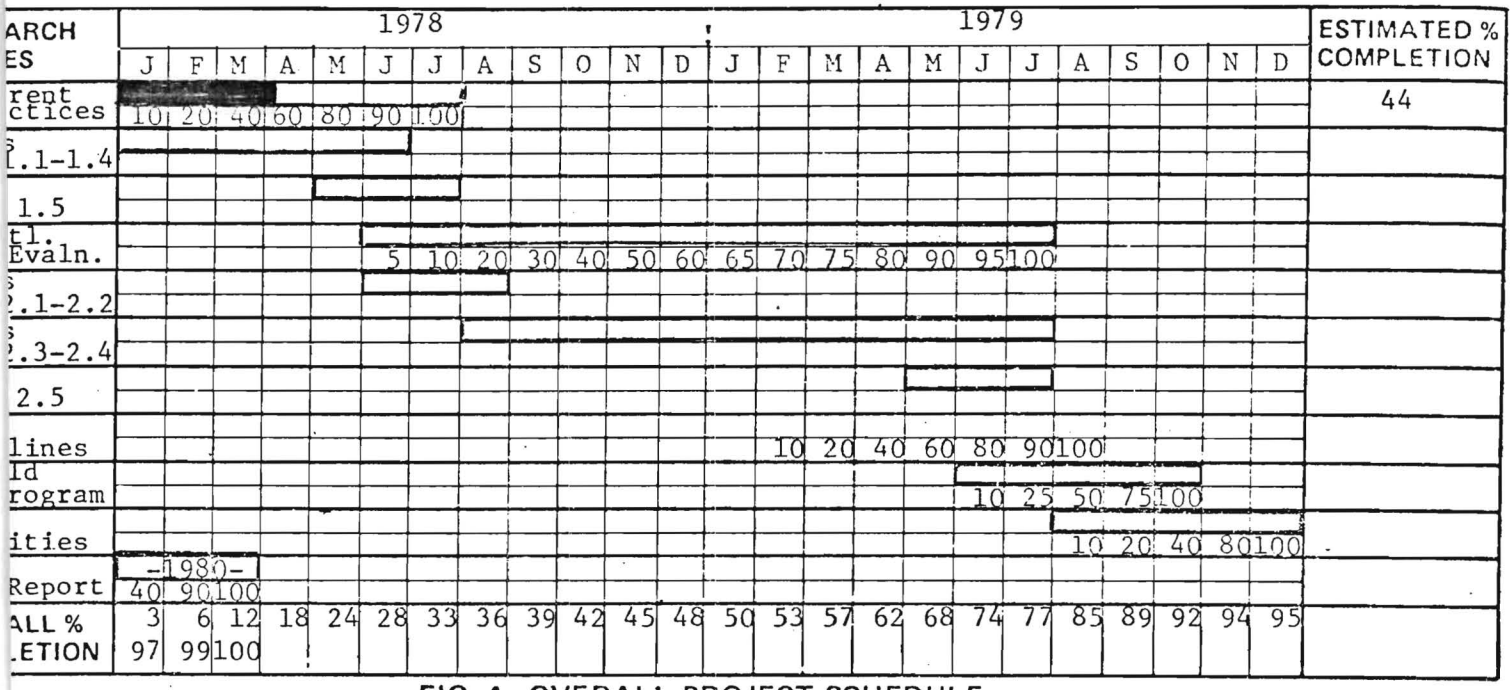


FIG. A—OVERALL PROJECT SCHEDULE

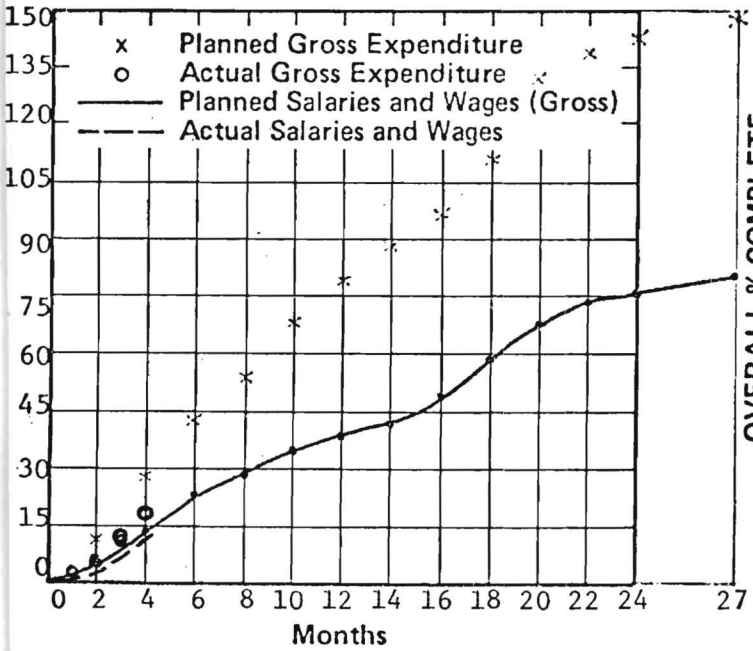


FIG. B—CONTRACT FUNDS

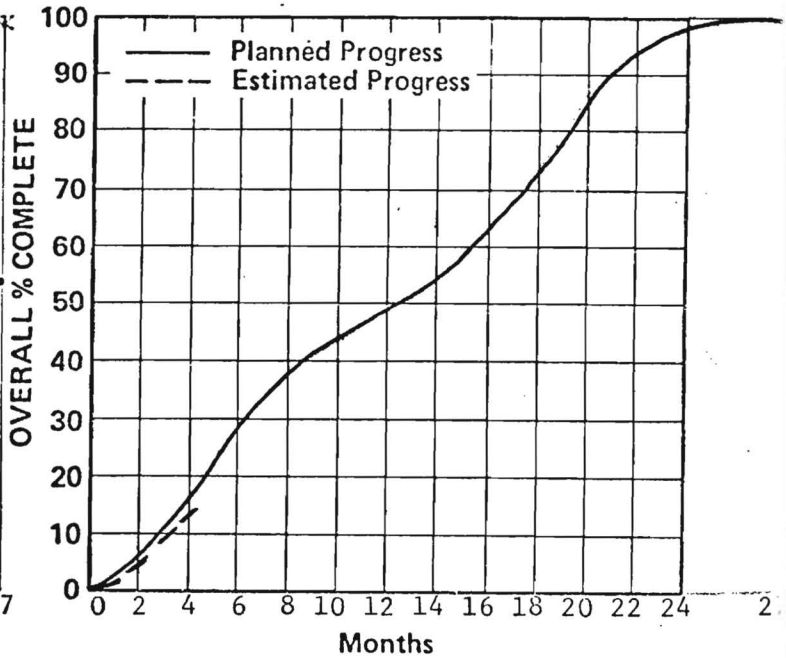


FIG. C—CONTRACT PERIOD

Funds Expended	%	12.6%
Contract Amount	$	149,231
Expended this Month	$	6,350
Total Exp. To Date	$	18,750
Balance	$	130,421

Time Expended %	13.2%
Starting Date	January 1, 1978
Completion Date	March 31, 1980

Salaries and Wages Estimated This Month	$	4,785
Salaries and Wages Spent This Month	$	3,545
Accumulated Salaries and Wages To Date	$	10,516

A-2092
Anna Lee

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

June 30, 1978

Harry A. Smith
Projects Engineer, NCHRP
Transportation Research Board
2101 Constitution Circle N.W.
Washington DC 20418

Reference: NCHRP 4-14, FY '78: "Coating Systems for Painting Old and New Structural Steel."

Dear Harry:

Enclosed are three copies of the Quarterly Progress Report for June 30, 1978. The remaining 42 copies are being sent to your attention under separate cover. We are proceeding to order raw materials for making up the paints for the Experimental Phase, Task 2, of our project. There are several alternatives for applying these topcoats to old intact painted surfaces and we should be able to report our plan for this portion of our study.

Your comments and those of your panel will be appreciated as soon as convenient, if you have changes to suggest.

Sincerely,

Daniel J. O'Neil, Ph. D.
Principal Investigator

and

Frank A. Rideout
Senior Research Scientist

QUARTERLY PROGRESS REPORT

to the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

on Project

NCHRP 4-14 FY '78

Coating Systems for Painting Old, and New Structural Steel

for period

April 1, 1978 to June 30, 1978

from

Dr. Daniel J. O'Neil (Principal Investigator)

Chief, Chemical and Material Sciences Division
Technology and Development Laboratory
Engineering Experiment Station
Georgia Institute of Technology
Atlanta GA 30332

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

P Project No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL Fy' 78 Month June 78
ch Agency Georgia Tech Research Institute (Engineering Experiment Station
al Investigator Dr. Daniel J. O'Neil (Telephone: 404-894-3095)

ARCH ES	1978 J	F	M	A	M	J	J	A	S	O	N	D	1979 J	F	M	A	M	J	J	A	S	O	N	D	ESTIMATED % COMPLETION
rent ctices	10	20	40	60	80	90	100																		80%
.1-1.4																									
1.5																									
tl. Evaln.						5	10	20	30	40	50	60	65	70	75	80	90	95	100						10%
.1-2.2																									
.3-2.4																									
2.5																									
lines														10	20	40	60	80	90	100					
ld rogram																		10	25	50	75	100			
ities																				10	20	40	80	100	
Report	-1980- 40	90	100																						
ALL % ETION	3 97	6 99	12 100	18	24	28	33	36	39	42	45	48	50	53	57	62	68	74	77	85	89	92	94	95	27%

FIG. A—OVERALL PROJECT SCHEDULE

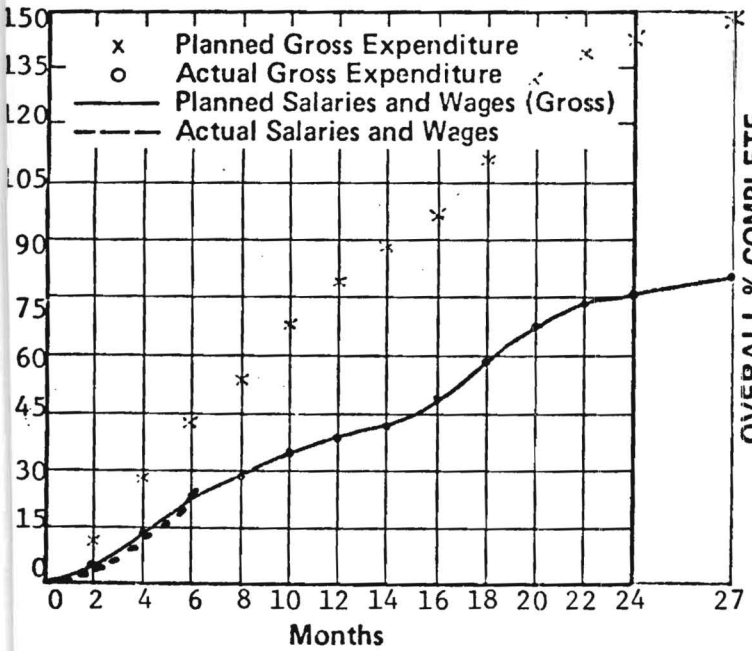


FIG. B—CONTRACT FUNDS

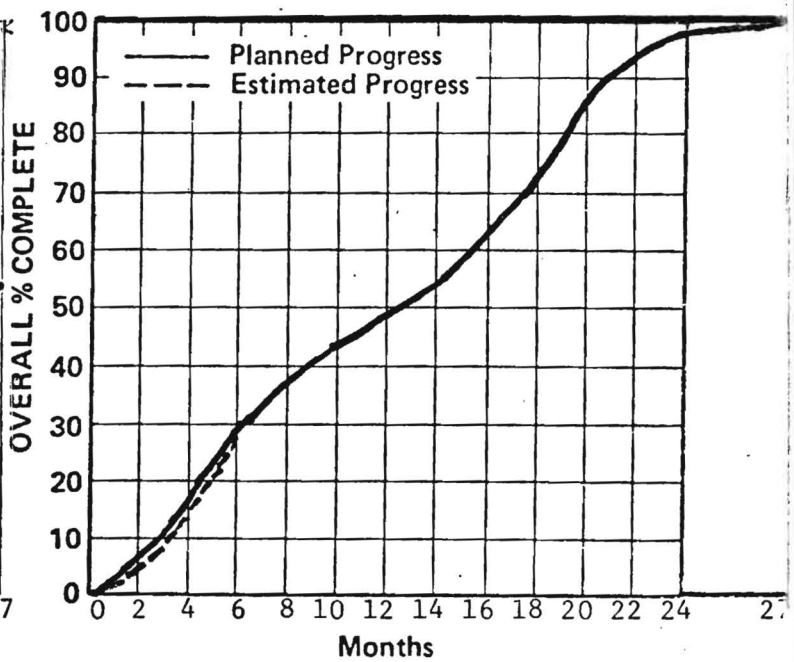


FIG. C—CONTRACT PERIOD

Funds Expended	%	27.9	
Contract Amount	$	149,231	
Expended this Month	$	11,769	
Total Exp. To Date	$	41,672	
Balance	$	107,559	

Time Expended %		28.0
Starting Date		January 1, 1978
Completion Date		March 31, 1980

Salaries and Wages Estimated This Month	$	3,600
Salaries and Wages Spent This Month	$	6,439
Accumulated Salaries and Wages To Date	$	22,334

/2/75

20.0008

Second Quarterly Progress Report to NCHRP June 30, 1978

Project 4-14 FY'78: Coating Systems for Painting Old and New Structural Steel
(Georgia Tech #A2092)

1. Objective: To prepare tentative guidelines for the use of existing and recently developed non-proprietary coating systems for the painting of structural steel, with emphasis on such considerations as: (a) health and environment, (b) exposure conditions, (c) application requirements, and (d) economics.

2. Statement of Work

PHASE 1. Current Practices

TASK 1.1 82 Articles have been retrieved and studied after selection from 219 abstracts which were selected from 1382 reference titles from literature on painting steel structures published mostly since 1968.

TASK 1.2 Most states like New York and New Jersey use an alkyd paint system with basic silico lead chromate after wire brushing rust and steam cleaning tight paint.

TASK 1.3 Raw material suppliers are making recommendations to support the work at Phase II.

TASK 1.4 SSPC and NASA have provided some of their literature. More data is needed from the PACE committee.

TASK 1.5 State-of-the-Art Report will be delayed from the original schedule, as agreed, while we develop more effective communication with the state DOT's. This task work will be extended throught the whole project term and included with the effort of Phases 3 and 4.

PHASE 2. The experimental evaluation of recently developed systems is ahead of budget. The criteria used in selecting the candidate systems were:

TENTATIVE CRITERIA FOR SELECTION OF EXPERIMENTAL COATING SYSTEMS

1. Surface preparation - at least good commerical blast cleaning
2. Application - easy for experienced painter;
3. Materials commercially available;
4. Reasonable initial cost (Less than or equal to $\$2.00/ft^2$);
5. Recoatable;
6. Minimum content of compounds containing lead, mercury, cadmium chromium, amines etc.;
7. Minimum level of solvent and acceptable by Rule 66 and 442.
8. At least one successful field trial of two or more years duration.

An additional restraint was placed on the selection process in that the systems chosen were to be suitable for the marine environment at the Brunswick, Georgia exposure site. It is doubtful that an all latex system is economically justified in the marine climate at the present state of development but this system should prove suitable for rural environments. The coating systems chosen for the experimental program were selected by consensus of the project team. For new structural steel, the matrix of coating systems is:

Topcoat \ Primer	Zinc-Rich Inorganic	$ZnPO_4$/Acrylic Latex	$ZnPO_4$/Vinyl	Epoxy TiO_2 Polyamide
Polyurethane*	X	X		X
Chlorinated Rubber	X	X		
Epoxy	X	X		
Acrylic Latex	X	X		
Vinyl	X	X	X	

*Includes epoxy-polyamide tiecoat

The coatings systems for old structural steel will be the same as the coatings for new structural steel where cleaning removes old paint and rust down to bare metal. For painting old structural steel in which the weathered paint is still sound and intact, only the topcoats will be used.

The coating systems given above will be used in a fractional factorial design to study the effects of surface treatment (e.g. commercial blast and wire brush) film thickness, substrate (new and old structural steel), and pigmentation as the performance of the coatings in an actual weathering environment and an accelerated weathering environment. The control coating system for new structural steel that is blast cleaned will be AASHTO standard specification M 229-74, type II (medium oil alkyd with basic lead silico chromate corrosion inhibiting pigment) with New York State Specification 708-12 Topcoat (alkyd). For the wire brush cleaned substrate, the primer control will be AASHTO Standard Specification M229-74, type I (long oil alkyd) and the topcoat again will be New York State Specification 708-12.

PHASE 3. Preparation of Guidelines - to begin in February 1979.

PHASE 4. Design of Field Evaluation Program - to begin June 1979.

PHASE 5. Priorities for Needed Research - to begin August 1979.

FINAL REPORT: Draft copy due December 31, 1979.

A-2092

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

August 7, 1978

Mr. Harry Smith
Staff Engineer - NCHRP
Transportation Research Board
2101 Constitution Ave., N.W.
Washington, D.C. 20418

Re: NCHRP 4-14, FY '78, Coating Systems for Painting Old and New Structural Steel

Dear Harry:

I enclose three copies of the monthly progress schedule for the month of July, 1978 on the subject project.

I regret the late submission and hope that it does not seriously inconvenience you.

On an overall basis we are proceeding on schedule. While we await a final decision on actual coating systems, we have progressed into phase III ahead of schedule. In fact, this is a logical consequence of our work under Phase I.

We are preparing a response to panel comments and are reevaluating our initial recommendations in light of their comments and as a result of recent findings from Frank Rideout's recent meetings which included an evaluation of the PACE program. You will receive our response within days.

We will look forward to your comments.

Yours sincerely,

Daniel J. O'Neil, Ph.D.
Principal Investigator

Attachment

TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

P Project No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL Fy' 78 Month July '78
ch Agency Georgia Tech Research Institute (Engineering Experiment Station
al Investigator Dr. Daniel J. O'Neil (Telephone: 404-894-3095)

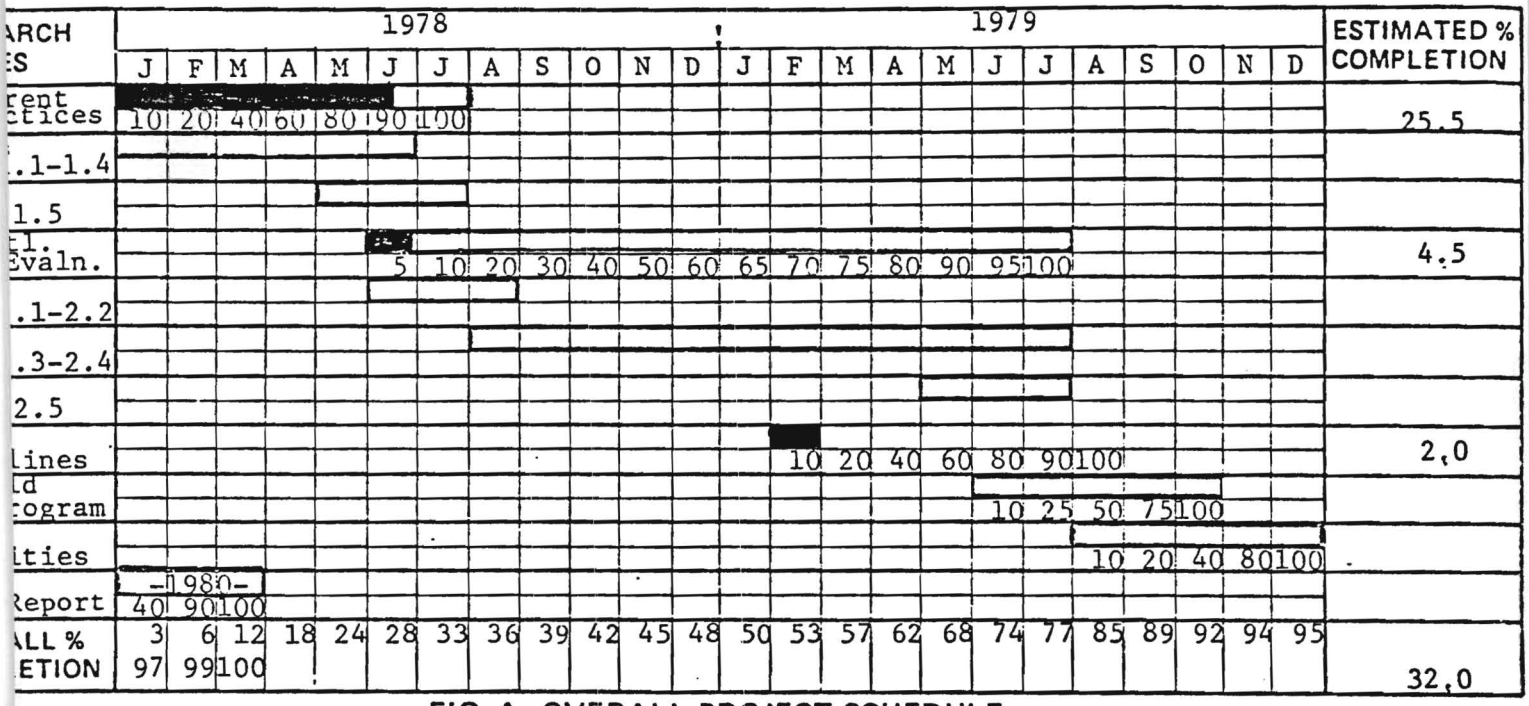


FIG. A—OVERALL PROJECT SCHEDULE

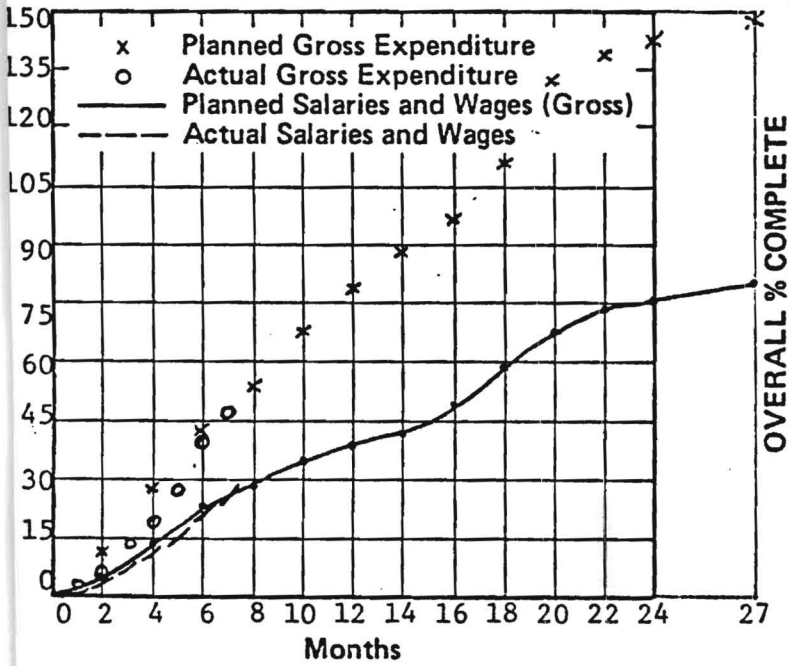


FIG. B—CONTRACT FUNDS

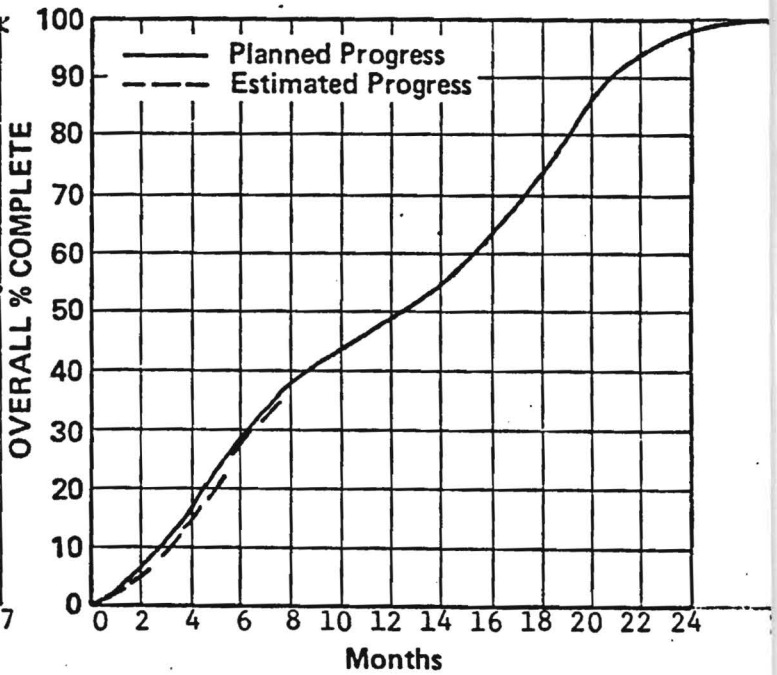


FIG. C—CONTRACT PERIOD

Funds Expended	%	31.7
Contract Amount	$	149,231
Expended this Month	$	6,482
Total Exp. To Date	$	47,232
Balance	$	101,999

Time Expended %	31.5
Starting Date	January 1, 1978
Completion Date	March 31, 1980

Salaries and Wages Estimated This Month	$	3,591
Salaries and Wages Spent This Month	$	3,192
Accumulated Salaries and Wages To Date	$	25,176

H-2092

QUARTERLY PROGRESS REPORT

to the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

on Project

NCHRP 4-14 FY'78

Coating Systems for Painting Old and New Structural Steel

for period

July 1, 1978 to September 30, 1978

from

Dr. Daniel J. O'Neil, Principal Investigator
Chief, Chemical and Material Sciences Division
Technology and Development Laboratory
Engineering Experiment Station
Atlanta, Georgia 30332

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

P Project No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL Fy' 78 Month Sept. 78
ch Agency Georgia Tech Research Institute (Engineering Experiment Station
al Investigator Dr. Daniel J. O'Neil (Telephone: 404-894-3095)

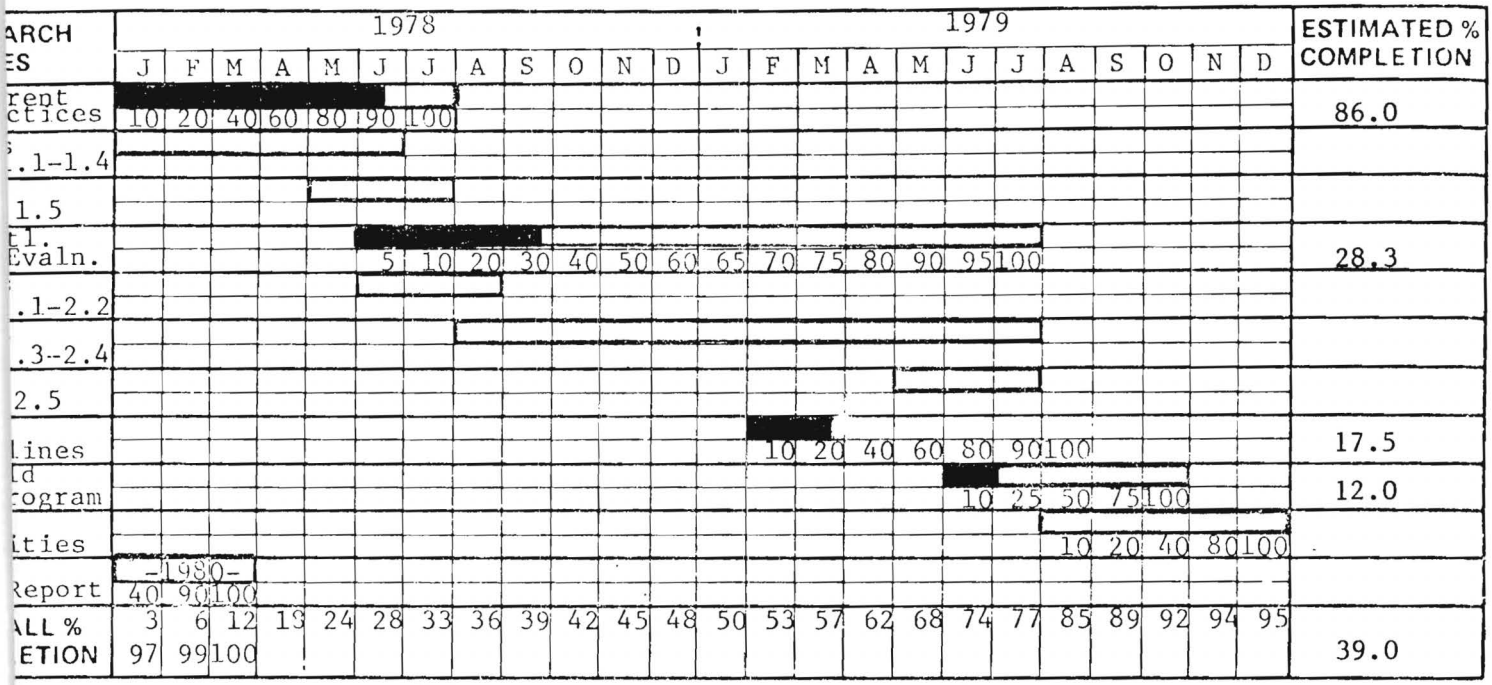


FIG. A--OVERALL PROJECT SCHEDULE

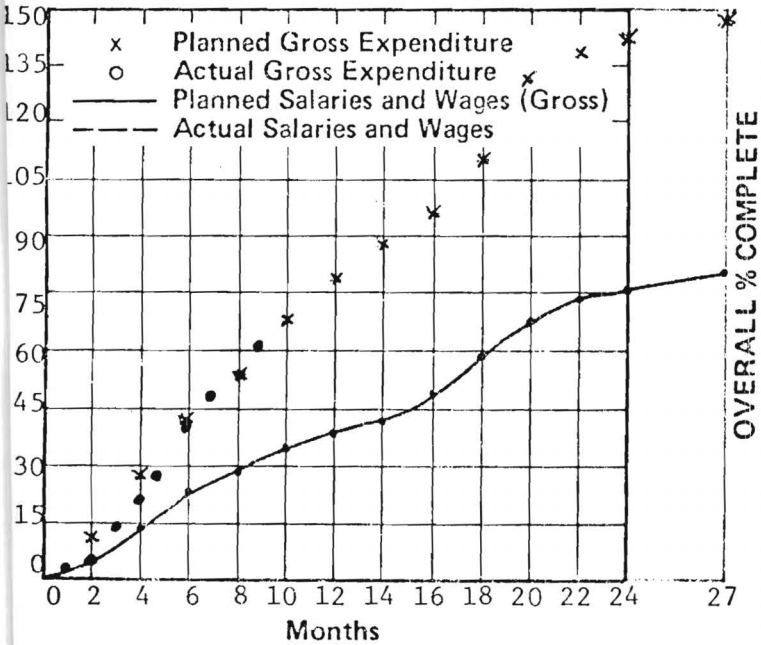


FIG. B--CONTRACT FUNDS

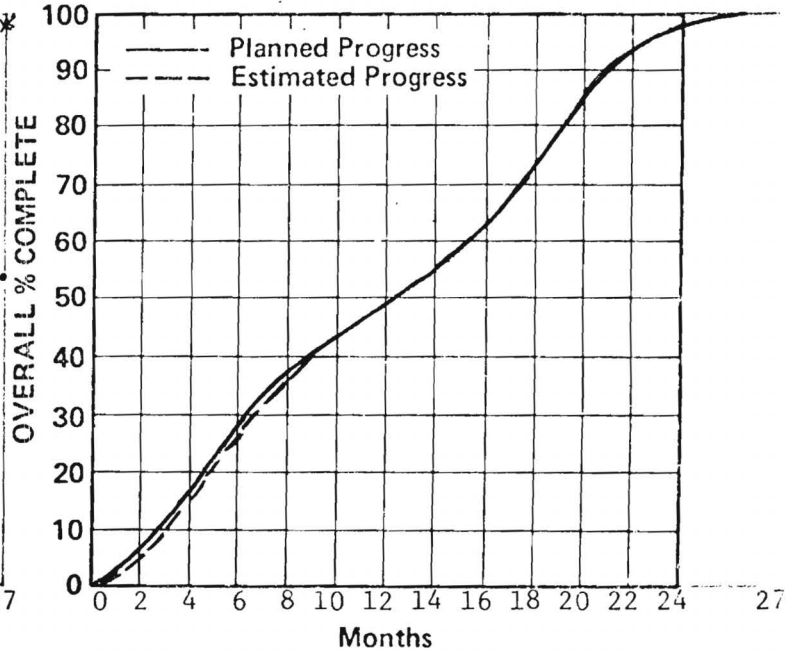


FIG. C--CONTRACT PERIOD

Funds Expended	%	40.6	
Contract Amount	$	149,231	
Expended this Month	$	5,944.40	
Total Exp. To Date	$	60,631.	
Balance	$	88,600.	

Time Expended %	40.0
Starting Date	January 1, 1978
Completion Date	March 31, 1980

Salaries and Wages Estimated This Month	$	2,400.00
Salaries and Wages Spent This Month	$	3,100.90
Accumulated Salaries and Wages To Date	$	31,934.73

/2/75

20.0008

Third Quarterly Progress Report to NCHRP September 30, 1978

Project 4-14 FY'78: Coating Systems for Painting Old and New Structural Steel (Georgia Tech #A-2092)

I. Objective

The objective is the preparation of guidelines for the use of existing and recently developed non-proprietary coating systems for the painting of structural steel with emphasis on such considerations as:

(a) health and environment

(b) exposure condition

(c) application requirements

(d) economics.

II. Faithfulness to Working Plan

We report our work about 40% complete through one third of the contract duration as we gather data on present practices and new coating technology. Once the experimental paints are prepared and applied to the steel test panels the manpower assignment will be reduced in the monthly schedule to fit the overall plan.

Recent effort has concentrated on the selection of coating systems to be tested in the marine atmosphere near the Sidney Lanier Bridge in Brunswick, Ga. with particular emphasis on health and environment restrictions anticipated by the early 1980's. Acceptable systems for less severe exposure conditions will be easier to select even though the same future health and environment restrictions will still apply. The application requirements and other economics will also pertain to all zones of exposure

besides Zone 2B defined on page 11 of NCHRP Report 74, "Protective Coatings for Highway Structural Steel."

Our evaluation of current practices and experience (Phase 1) is not completed as originally scheduled. The questionnaire will be made easy for the state DOTs to answer by asking them to update the information on their state specifications from the NCHRP Report 74B. This Quarterly Progress Report will be included with the questionnaire to solicite their experience and comments.

Our preparation for Phase 2, Experimental Evaluation of Recently Developed Systems has gotten us into Phase 3 Guidelines and Phase 4 Design of Field Evaluation Program sooner than shown in our original working plan. Elements of our state-of-the-art report (Task 1.5) are to be found in all of the other phases of our report.

We now expect Phase 1 to continue to the final report Phase 5.

III. Progress by Phase

Task 1.1 With emphasis on publications since 1968, literature references have been selected and reviewed for our possible use and listing in our literature update bibliography. A card file (5" X 8") with abstracts is being built and classified in the same arrangement as the NCHRP 74 report. These include:

Government Reports	65
Journal Articles	170
State Specifications	10

Task 1.2 Preliminary contacts have been made with eleven state highway agencies and eight Federal agencies concerned with paint specs. Personal contact is the most effective method of communication. We must now, also, get a questionnaire out to all the states (see proposed example attached).

Task 1.3 Our literature survey has produced few articles giving case histories of latex coating systems. This scarcity has been filled in by supplier product literature. At the present, latex coating system development is a very active field; changes in pigment grades and resin improvements require constant updating. The status is given in the discussions on Phase 2 Report which follows below.

Task 1.4 Our most fruitful contacts with other laboratories have been with NACE Task Group T-6H-15 on Surface Preparation and with SSPC to review the latest PACE two year exterior exposure results on new corrosion inhibitive pigments in latex, alkyds, and vinyls.

Task 1.5 As discussed above and agreed with by Harry A. Smith, NCHRP Project Engineer, the State-of-the-Art-Report will be extended to the final report.

Phase 2. Experimental Evaluation of Recently Developed Systems

The selection criteria, originally listed in the Second Quarterly Progress Report (June 30, 1978), have been expanded after further study and analysis of Phase 1 and the initially proposed experimental program and review of the panel's comments. Information gained in the PACE program has also influenced the experimental revisions.

The criteria used in the selection of the experimental coating systems follow:

1. Projected Service Life
2. Cost/Service Life Ratio
3. Commercial availability
4. Availability of a non-proprietary formulation
5. Ease of application
6. Surface preparation requirements
7. Acceptable initial cost (less than or equal to $2.00/sq. ft.)
8. Recoatability
9. Minimal solvent levels (acceptable by Rule 66 and 442)
10. Toxicology (minimum content of compounds containing lead, mercury, cadmium, chromium, amines, etc.)
11. Reasonable field experience (prefer one successful field trial of two or more years duration as a minimum)
12. Resistance to a marine environment (project performance equal to but preferably better than the alkyd control)

The experimental program is divided into two sections: coating systems for new structural steel and coatings for old structural steel with intact,

weathered paint. About 184 test panels are to be prepared for the total experimental phase to test 19 coating systems and an alkyd/lead based pigment control.

New Structural Steel

The coating systems (primer and topcoat) selected for new steel are given in Table 1. The surface treatment for the new structural steel will be at least near-white blast.

Table 1. Coating Systems for New Structural Steel

	Primer			
Topcoat	Zinc Rich Inorganic	Latex/$Zn_3(PO_4)_2$	Vinyl/$Zn_3(PO_4)_2$	Epoxy-Polyamide
Polyurethane	X[a]	X		X
Acrylic Terpolymer Latex	X	X		
Epoxy-Polyamide[b]	X	X		
Acrylic Copolymer Latex	X	X[C]		
High-build Vinyl	X	X	X	

[a] Requires a tiecoat
[b] Non-chalking type epoxy resin
[c] A total of eight systems are counted here to evaluate several different corrosion inhibitor pigments

The tests to be used in comparing these various candidate systems will be natural exposure weathering in a marine environment near Lanier Bridge (Brunswick, Georgia), salt fog resistance, and accelerated weathering

(Weather-o-Meter exposure). The systems will be evaluated for corrosion resistance, chalk resistance, color retention, and adhesion. The marine environment testing will be performed with the systems at two film thickness levels: 3-5 mils and 6-8 mils. The salt fog and weatherometer testing will be done on the systems at the lower film thickness in order to obtain early results. (We recognize that in actual bridge maintenance recommended paint thickness is approximately 10 mils or more.) The control coating system for the tests on the new structural steel is to conform to AASHTO standard specification M 229- 74, type II for the primer (medium oil alkyd pigmented with basic lead silico chromate corrosion inhibiting pigment); the topcoat is New York State specification 708-12 topcoat (alkyd base). The test program for the new structural steel is summarized in Table 2.

Table 2. Test Matrix for Coating Systems on New Structural Steel

	Test		
Film Thickness	Marine Exposure[a]	Salt Fog[b]	Weather-O-Meter[c]
one coat primer one or more topcoats ∿ 3-5 mils total	X	X	X
one coat primer one or more topcoats ∿ 6-8 mils total	X		

[a]Lanier Bridge area, Brunswick, Ga.
[b]5% NaCl, 95-100°F
[c]Xenon Lamp: 102 minutes of light followed by 18 minutes of darkness with water spray; panel temperature to be noted.

Zinc phosphate is the only new corrosion inhibiting pigment included in the test program represented in Table 1. Other corrosion inhibiting pigments will be evaluated using the latex topcoat/latex primer for the inhibitor pigments compatible with water-borne systems and the vinyl topcoat/vinyl primer for those inhibitor pigments that are not compatible with water-borne systems. Alternate pigments include a zinc phospho-oxide complex (Nalzin SC-1, NL Industries, Inc.), a barium metaborate (Busan 11-M1, Buckman Laboratories), basic zinc-calcium molybdate (Molywhite 212, Sherwin-Williams), calcium borosilicate (Halox CW-2230, Halox Pigment Division of Hammond Industries), water-dispersible aluminum flake, barium and/or strontium phospho silicate (Hammond Industries) and micaceous iron oxide. Seven of these will be evaluated as part of the program for new structural steel.

Review of Table 1 shows that chlorinated rubber has been dropped as a topcoat in the experimental design reported in the Second Quarterly Progress Report. This was done since more emphasis on water-borne systems was desired in Phase 2, consistent with the overall objectives of the program. Further, it was felt that the attributes of chlorinated rubber based paints are well documented in the literature so that little new information would be generated by its inclusion. The conventional epoxy-polyamide topcoats, of course, are subject to the same analysis. The recent development of non-chalking epoxy resins is the reason for their retention in the program. Coatings using these epoxies are also claimed to be readily recoatable. Epoxy resin technology also has a greater probability of development into a high-solids coating system than the chlorinated rubber.

For new structural steel, a total of nineteen coating systems will be evaluated as outlined in Table 2. Since a control coating will be included and the tests will be performed in duplicate, a total of 160 panels of new steel will be coated and tested.

Old Structural Steel

The evaluation of new coating systems for painting old structural steel with weathered, intact paint will encompass the topcoat systems listed in Table 1. Surface preparation will entail cleaning and removal of contamination, dust, and chalking residue. Near-white blast cleaning of the old steel as a subsection of the experimental program will not be done since it is felt that such a surface will so closely resemble new steel that little new information would be obtained. Loose paint will be removed by wire brush but rust spots, if they are present, will be blast cleaned to a near-white condition and the bare areas spot primed with organic zinc-rich. The test panels are now expected to be cut from sections of an old bridge located in the Atlanta metropolitan area. The Georgia specification coating on these pieces will be identified when the exact bridge sections are obtained. The coating will be representative of the type used on most existing highway bridges, at least in the eastern part of the country. If the bridge sections cannot be obtained old, coated KTA panels from earlier exposure tests at Georgia Tech will be used.

The candidate topcoats plus the New York State specification topcoat will be evaluated at two film thicknesses at the marine environment exposure site. The thin films, as with the tests on the new structural steel, will be thick enough to have the same film structure as coatings at recommended film thicknesses (maintenance practice). The thin films are used to provide a measure of acceleration to the test. The coatings will be

evaluated for intercoat adhesion, corrosion resistance, color retention and chalk resistance. The test program for all structural steel is summarized in Table 3. Formulations are in Table 4.

Table 3. Coating Systems for Old Structural Steel

Cleaned, Aged Primer: Georgia Specification Alkyd/Lead Pigment		
Refinish	one coat, 2 mils	two coats, 4 mils
Polyurethane	X	X
Epoxy/Polyamide	X	X
Acrylic Copolymer Latex	X	X
Acrylic Terpolymer Latex	X	X
High-Build Vinyl	X	X

Panel Preparation

All flat panels for exterior exposure will be checked carefully for cleanliness contamination and defects. Thickness of coatings will be measured in a pattern over the whole panel and a profile recorded. The coated panels will be allowed to dry for a minimum of 14 days in the laboratory before testing. The same conditioning period will be used for all coatings. Panels will be coated with primer on both sides and overcoated on all edges with tape or a vinyl paint, such as SSPC-Paint 9-64, in the manner recommended by SSPC. This will minimize the premature failures due to exposed or sharp angles and other so-called edge effects and permit evaluation of a replicate section of a normal painted surface.

Table 4. Some Candidate Formula Compositions

All formulations will meet rule 66 or 442 CARB regulations and will use the minimum volume of organic solvent for satisfactory application. A partial list of compositions follows: (References are from supplier's literature).

REFERENCE	TYPE	MAJOR COMPONENTS	WEIGHT RATIO	PIGMENT VOLUME CONCENTRATION
255142A	POLYURETHANE (MOBAY)	DESMOPHEN 650A65 MULTRON R221 75 DESMODUR N75 TiO_2 R-960	313 30 285 248	14
F 125-25	EPOXY/ POLYAMIDE SHELL: UNION CAMP	SHELL DRH151.3 UNIREZ 2188 TiO_2 R-960 $Al_2(SiO_4)_3$	238 233 407 102	26
31226-94-1	LATEX PRIMER	AROLON X-820 AROPLAZ 1271 RED IRON OXIDE Ba METABORATE $CaCO_3$	500 26 100 80 100	26.2
31226-103-1	LATEX PRIMER	AROLON X-820 AROPLAZ 1271 TiO_2 R-901 MOLYWHITE 212 (S-W) MICA $CaCO_3$	535 27 240 83 23 50	30.4
46-3	LATEX PRIMER	AROLON X-820 AROPLAZ 1271 RED IRON OXIDE ZINC PHOSPHO OXIDE MICA $CaCO_3$	500 26 100 80 36 100	26.6

Table 4. Some Candidate Formula Compositions (Continued)

REFERENCE	TYPE	MAJOR COMPONENTS	WEIGHT RATIO	PIGMENT VOLUME CONCENTRATION
P-23-1	LATEX PRIMER	RHOPLEX MV-23 TiO_2 R-960 $CaCO_3$ ZnO	667 151 53 12	19.3
CHH766	LATEX PRIMER	AROLON X820 Ca BORO SiO_4 TiO_2 $CaCO_3$	583 105 50 110	26.1
MP-3513	INORG. ZINC RICH	ZINC DUST MCE SILICATE	1132 698	61.0
HP-3662	ORGANIC ZINC RICH	ZINC DUST PKHH PHENOXY	1198 123	63.0
VP-3708	VINYL PRIMER	VMCA DID PHTHALATE TiO_2 R-966 $Zn_3(PO_4)_2$	207 52. 108 85	19.4
VP-3604	VINYL HIGH-BUILD	VMCA DID PHTHALATE TiO_2 R-766	210. 52 147.	12.7
PWB-23	LATEX ALUMINUM	MV-9 ALCOA PASTE 830	870 200	27.1

Table 4. Some Candidate Formula Compositions (Continued)

REFERENCE	TYPE	MAJOR COMPONENTS	WEIGHT RATIO	PIGMENT VOLUME CONCENTRATION
MIL-P-24441/1	EPOXY-POLYAMIDE (PRIMER)	EPON 815 VERSAMID 280B75 $MgSiO_4$ DIATOM SiO_2 TiO_2 TT-P-442	500 280 600 150 100	14.8%

Phase 3. Preparation of Tentative Guidelines

Task 3.1 The experience of Florida, California, Texas, Massachusetts, New Jersey, and Georgia supports the surface preparation, material selection, application and control testing selected in the preceding phase. Our tentative guidelines are evolving out of the detailed experience and continuing discussion with suppliers, corrosion engineers, panel members and DOT materials people.

The work of the PACE committee, the NACE Task Force T6-H-I5 and the new specifications of various branches of the Federal government are fitting together and promise to form the basis of our guidelines. The results of our questionnaire in Task 1.3 will bear heavily on our conclusions.

Phase 4. Design of Field Evaluation Program

Task 4.1 Our critical review of past and present field evaluation programs promises to be one of the most interesting aspects of the project. For example, the Massport Authority in East Boston had chosen a chlorinated rubber based coating to paint the badly corroded Tobin Mystic River Bridge because of chlorinated rubber's reported tolerance for limited surface preparation. Initially, the specification for surface preparation required commercial blast quality (SSPC-SP-6). For 1978, the surface preparation quality was increased to near-white blast (SSPC-SP-10). This change, of course, requires a reevaluation of the most economical coating system. Local pollution regulations coupled with complaints from area residents about blast debris have lead to the use of a vacuum blast system. The vacuum blast system supplants the use of conventional equipment with which blast debris was to be isolated and contained by a polyethylene walled structure that surrounded the blast area. This approach was only about

80% effective in containment. The field success of the vacuum blast equipment will be interesting to monitor.

We plan to review other case histories of new coating systems such as the Nitro Bridge in West Virginia, the Florida test bridges and the 1968 paint evaluation sponsored by Georgia DOT.

Future Work

The major tasks for the next quarter are the preparation of panels and the questionnaire. The literature collected will continue to be critically reviewed and compared.

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

September 21, 1978

William L. Pollock, Asst. Division Engineer
Division of Bridges
Missouri State Highway Department
Jefferson City, MO 65101

Dear Mr. Pollock:

Georgia Tech has begun a two year project (4-14) "Coating Systems for Painting Old and New Structural Steel" for the National Cooperative Highway Research Program and we would appreciate your help.

Attached is a copy of our third Quarterly Progress Report that includes our coating selections and plans for a modest test panel evaluation. May we have the benefit of any experience your people have had with systems like these and your comments?

Have there been any changes in your state's coating specifications since the NCHRP Report 74B prepared by SSPC in 1968? For your easy reply, we attach a copy of your state's 1968 summary. Please indicate any changes and return it to us. Thank you.

Yours sincerely,

Daniel J. O'Neil, Ph.D.
Principal Investigator
(404) 894-3095

Frank A. Rideout
Senior Research Scientist
(404) 894-3410

Attachments

FAR/ml

E 8

E HIGHWAY SPECIFICATIONS FOR PAINTING STEEL, PART I—SURFACE PREPARATION AND PAINT APPLICATION

	SPECIFICATION			PAINT APPLICATION						
	DATE	AMENDMENT	SURFACE CLEANING	REQUIRED	PERMITTED	AIR TEMP.	MOISTURE	DRY FILM THICKNESS (MILS)	CONTACT SURFACES	COMMENTS
	1961		SOLVENT HAND BLAST REQ.	BRUSH (4)	BRUSH SPRAY (SHOP)	40°F	AIR NOT MISTY	NOT SPECIFIED	SURFACES JOINED WITH HIGH TENSION BOLTS NOT PAINTED	COMMERCIAL GRADE OF BLAST CLEANING REQUIRED ON METAL SURFACES.

ISION AS OF October 1978:

From Page 23 NCHRP Report 74B

E 9

E HIGHWAY SPECIFICATIONS FOR PAINTING STEEL, PART II—PAINTS

E	SPEC. DATE	PRIMER		LB/ GAL.	INTERMEDIATE		FINISH COAT	
		PIGMENT	VEHICLE		PIGMENT	VEHICLE	PIGMENT	VEHICLE
RI	1961	RED LEAD MAGNESIUM SILICATE	RAW LINSEED OIL	--	RED LEAD SPANISH OR RED IRON OXIDE GRAPHITE MAGNESIUM SILICATE ALUMINUM STEARATE	RAW LINSEED OIL	ALUMINUM POWDER OR PASTE	SPAR VARNISH
		RED LEAD ALUMINUM STEARATE	RAW LINSEED OIL ALKYD RESIN SOLIDS	21.4				

ISION AS OF October 1978:

environmental regulations now apply to your painting?

new research can you tell us about that will impact your present practice?

Reply over or attach sheet.

PLICATION REQUIRED WHEN ENGINEER CONSIDERS SPRAY UNSATISFACTORY.
PLICATION REQUIRED FOR SURFACES INACCESSIBLE TO BRUSHES.
EQUIRED FOR INACCESSIBLE SURFACES.
PLICATION REQUIRED FOR FIELD COATS.
CLEANING DONE WITH GASOLINE, BENZENE, ETC.
ANING DONE WITH WIRE BRUSHES, SCRAPERS, CHISELS, ETC.
EANING ACCOMPLISHED BY PASSING OXYACETYLENE FLAME OVER SURFACE.
BLAST CLEANED TO BARE METAL.
TERGENT CLEANING ACCOMPLISHED BY USE OF STEAM UNDER PRESSURE WITH AN ADDED DETERGENT CLEANER.
LIEVED THAT THESE STATES ARE CONSIDERING THAT BLAST CLEANING BE REQUIRED ON ALL STRUCTURAL STEEL.

NATIONAL RESEARCH COUNCIL

H-2092

PROGRESS SCHEDULE

roject No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL Fy' 78 Month Oct. 1978

Agency Georgia Tech Research Institute (Engineering Experiment Station

nvestigator Dr. Daniel J. O'Neil (Telephone: 404-894-3095)

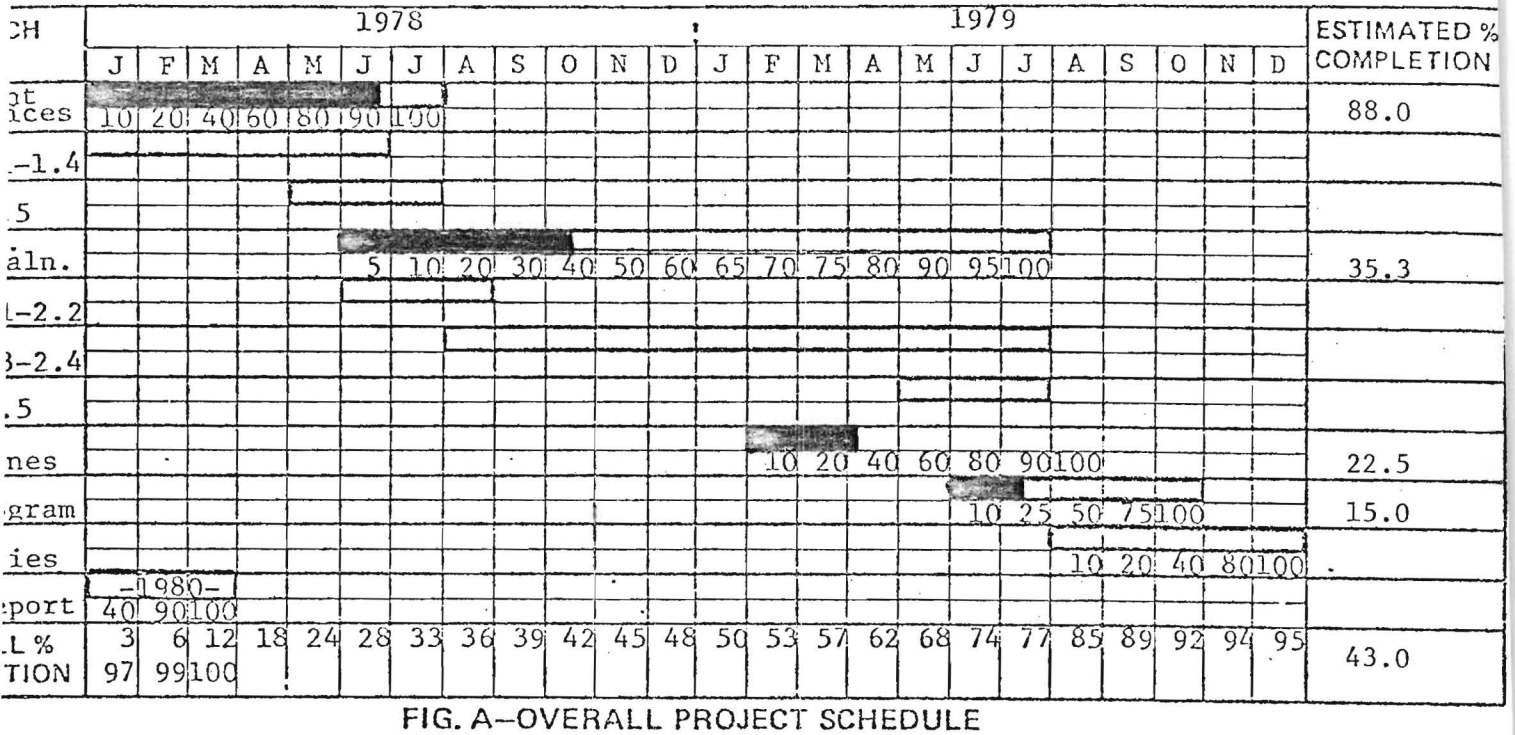


FIG. A—OVERALL PROJECT SCHEDULE

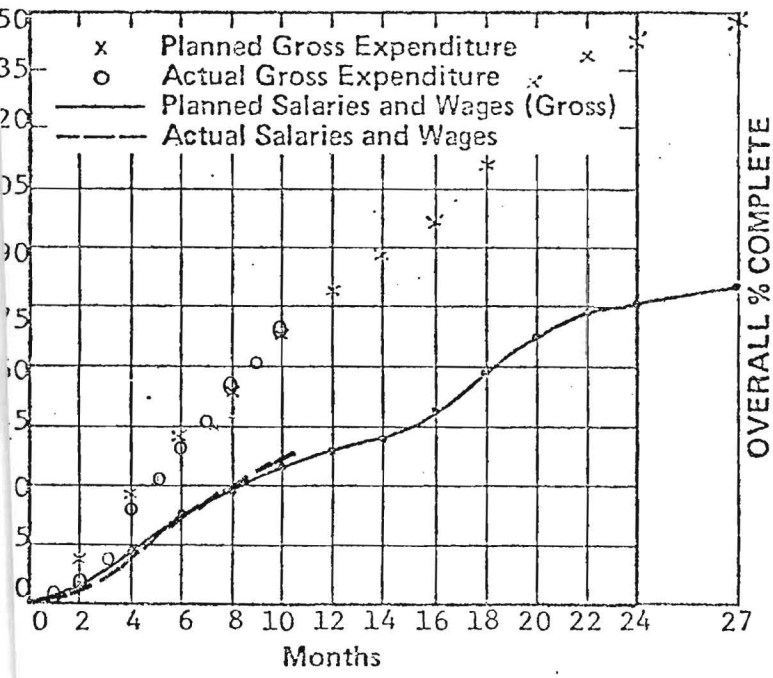


FIG. B—CONTRACT FUNDS

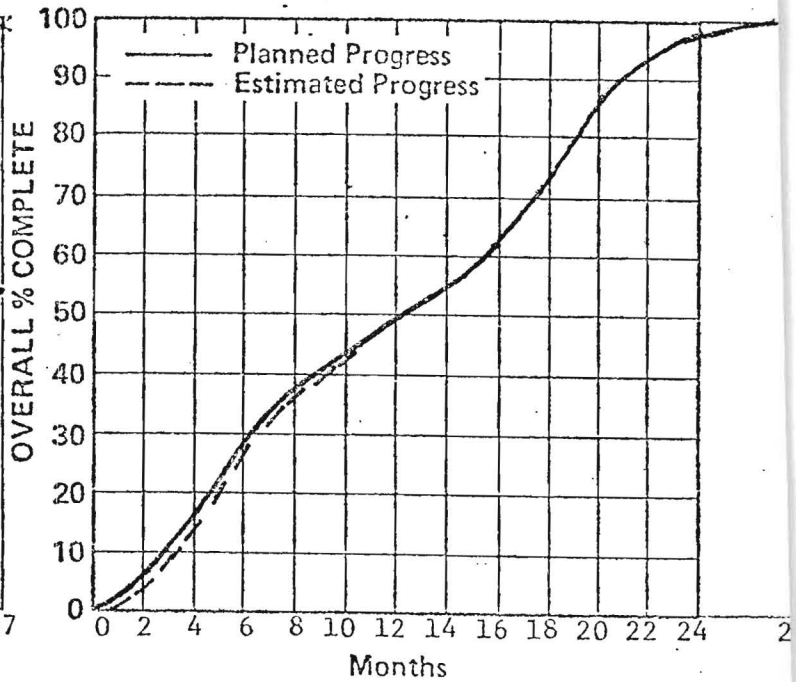


FIG. C—CONTRACT PERIOD

Funds Expended	% 43.6
Contract Amount	$ 149,231
Expended this Month	$ 5,649
Total Exp. To Date	$ 66,852
Balance	$ 82,379

Time Expended %	41.7
Starting Date	January 1, 1978
Completion Date	March 31, 1980

Salaries and Wages Estimated This Month	$ 2,400
Salaries and Wages Spent This Month	$ 2,722
Accumulated Salaries and Wages To Date	$ 34,770

2/75

20.0008

A-2092

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

December 1, 1978

Mr. Harry A. Smith
Project Engineer - NCHRP
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D. C. 20418

Re: Report of November 1978 on NCHRP 4-14, FY'78, Ga. Tech A-2092
"Coating Systems for Painting Old and New Structural Steel"

Dear Harry:

Enclosed are 3 copies of the November monthly progress schedule.

We are pleased to report that 22 state DOT's have replied to our questionnaire so far.

We have looked into the cementitious coatings, especially the more recent work, and find that indeed coatings for steel can be formulated that show remarkably good salt spray and durability on panels. The last report on Georgia DOT test panels at Brunswick was good and we will check them out when we prepare to expose our experiment panels.

In my capacity as Chairman of the Technical Advisory Committee of the Southern Society of the Coatings Technology, I will continue to monitor coatings for concrete and coatings using portland cement, so we may discuss this subject again before this contract is completed.

Note all of us working on the project, including Dan O'Neil, are now located at our Cobb County Research Facility. Our address remains the same for mail, but our new phone number is 404/428-9053.

Sincerely,

Frank A. Rideout
Principal Investigator

FAR:gp

TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

Project No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL FY' 78 Month Nov. '78
Agency Georgia Tech Research Institute (Engineering Experiment Station
Investigator Frank A. Rideout (Telephone: 404/428-9053)

CH	1978 J	F	M	A	M	J	J	A	S	O	N	D	1979 J	F	M	A	M	J	J	A	S	O	N	D	ESTIMATED % COMPLETION
pt ices	10	20	40	60	80	90	100																		88.0
1-1.4																									
.5																									
áln.							5	10	20	30	40	50	60	65	70	75	80	90	95	100					43.0
1-2.2																									
3-2.4																									
5																									
nes														10	20	40	60	80	90	100					23.5
gram																		10	25	50	75	100			20.0
ies																				10	20	40	80	100	0
port	-1980- 40	90	100																						2.0
L % TION	3 97	6 99	12 100	18	24	28	33	36	39	42	45	48	50	53	57	62	68	74	77	85	89	92	94	95	46.1

FIG. A—OVERALL PROJECT SCHEDULE

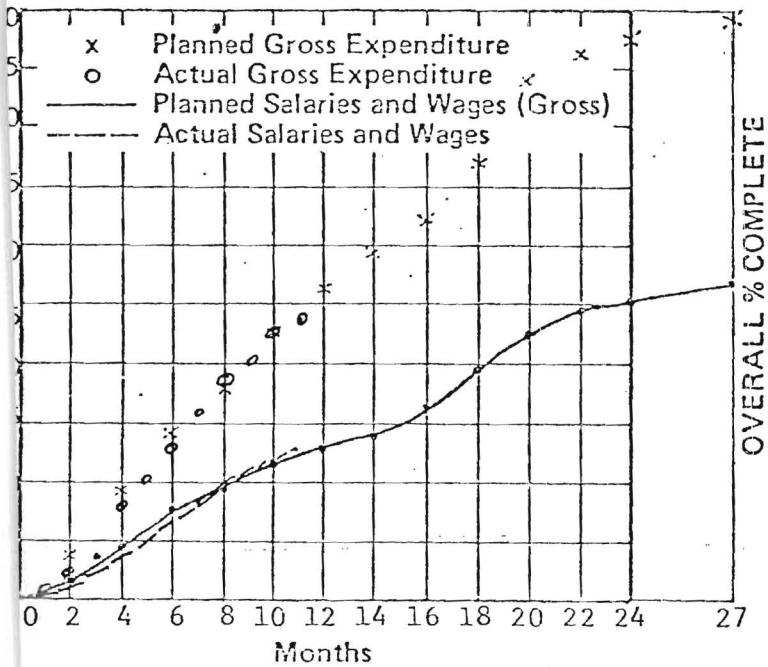


FIG. B—CONTRACT FUNDS

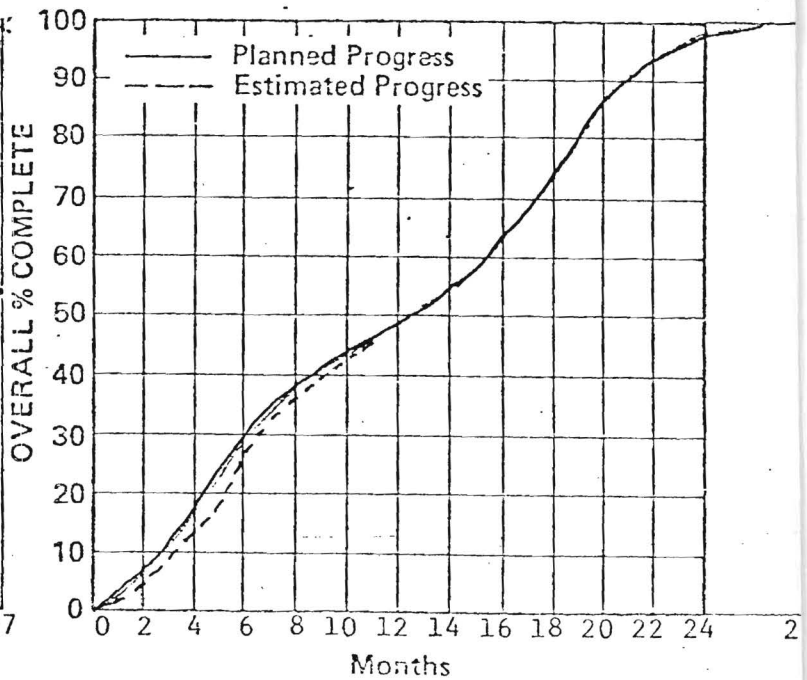


FIG. C—CONTRACT PERIOD

Funds Expended	%	
Contract Amount	$	149,231.
Expended this Month	$	5,893.
Total Exp. To Date	$	71,420.
Balance	$	77,811.

Time Expended %		47.0
Starting Date		January 1, 1978
Completion Date		March 31, 1980

Salaries and Wages Estimated This Month	$	2888.
Salaries and Wages Spent This Month	$	2902.
Accumulated Salaries and Wages To Date	$	37,511.

/75

20.0008

QUARTERLY PROGRESS REPORT

to the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

on Project

NCHRP 4-14 FY'78

Coating Systems for Painting Old and New Structural Steel

for period

October 1, 1978 to December 31, 1978

from

Frank A. Rideout, Principal Investigator
Senior Research Scientist
Chemical and Material Sciences Division
Technology and Development Lab
Engineering Experiment Station
Cobb County Research Facility
Atlanta, Georgia 30332

TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

P Project No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL Fy' 78 Month Dec. 1978
ch Agency Georgia Tech Research Institute (Engineering Experiment Station
al Investigator Frank A. Rideout (Acting) (Telephone: 404/428-9053)

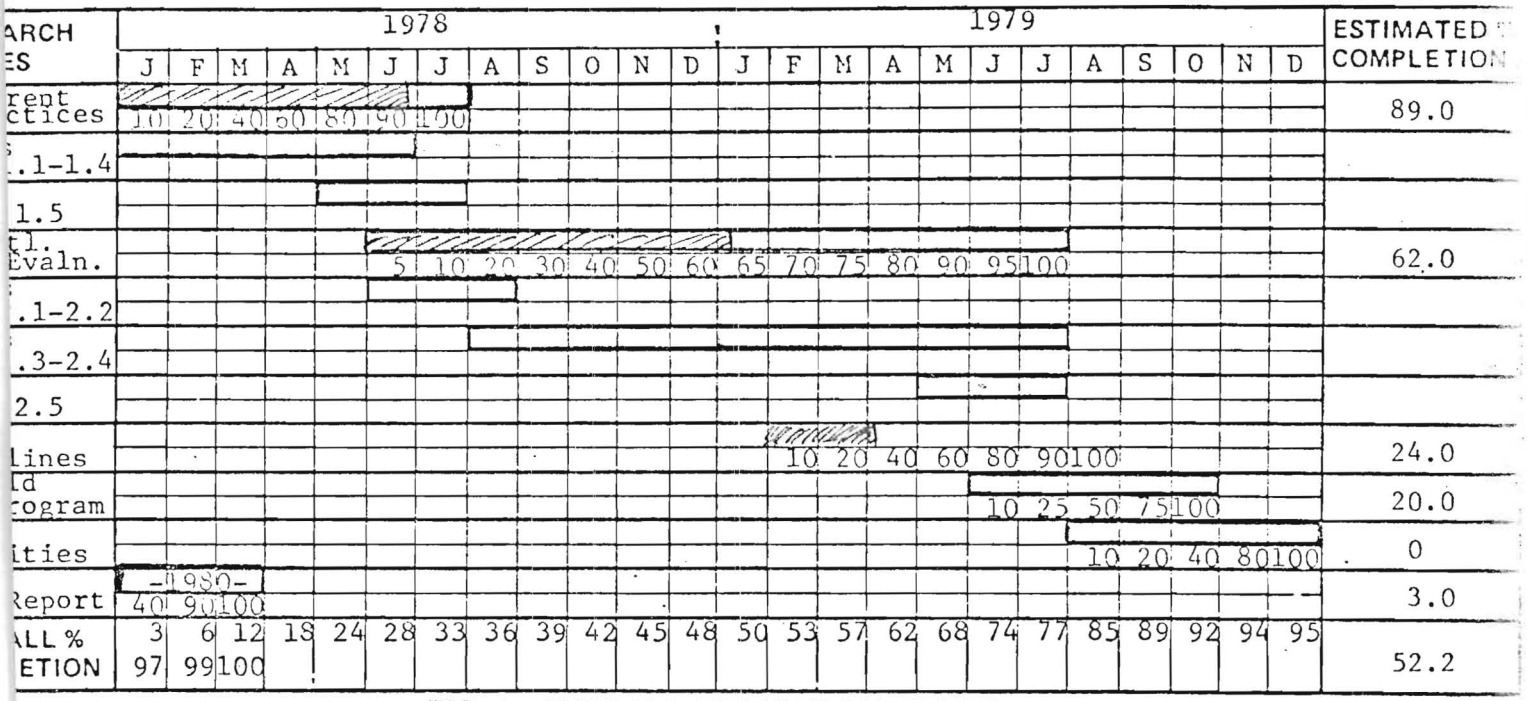


FIG. A—OVERALL PROJECT SCHEDULE

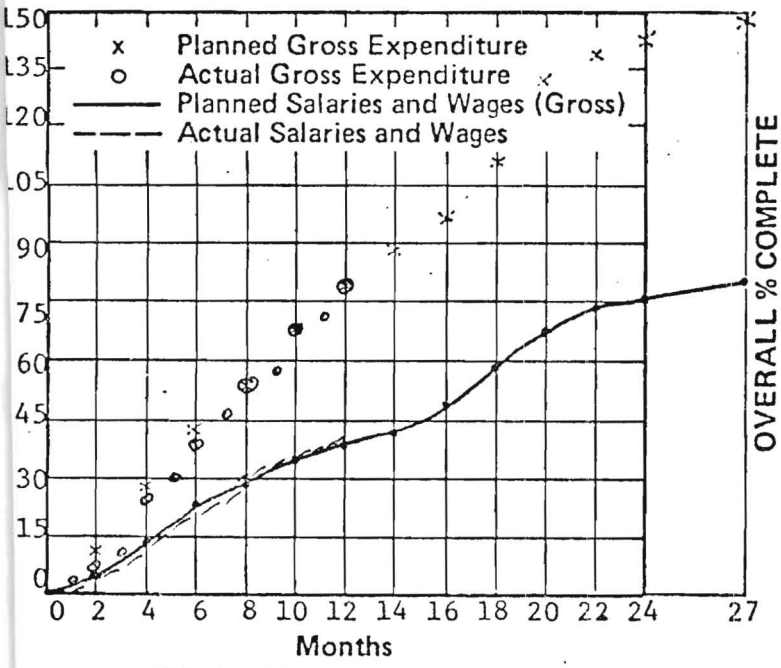


FIG. B—CONTRACT FUNDS

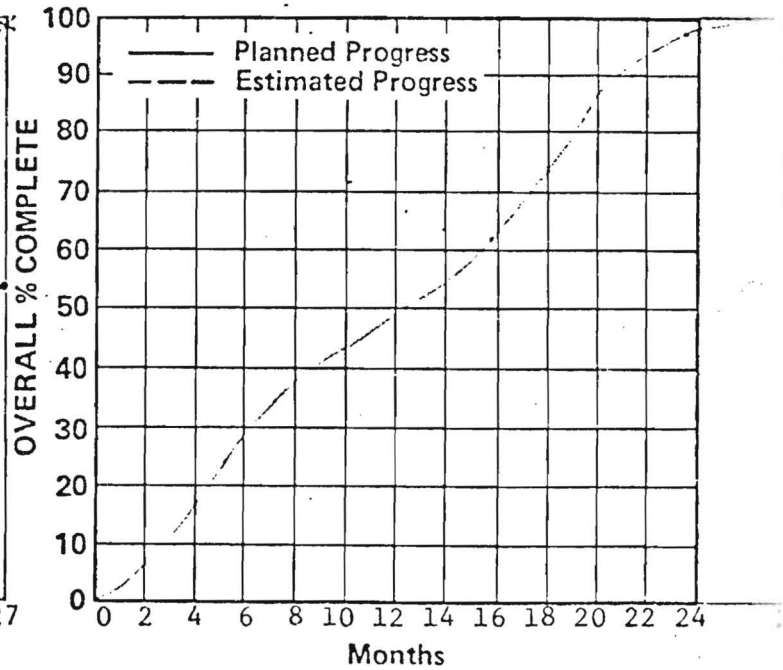


FIG. C—CONTRACT PERIOD

Funds Expended	%	53.0
Contract Amount	$	149,231
Expended this Month	$	7,436
Total Exp. To Date	$	79,136
Balance	$	70,095

Time Expended %	52.1
Starting Date	January 1, 1978
Completion Date	March 31, 1980

Salaries and Wages Estimated This Month	$	2,888.
Salaries and Wages Spent This Month	$	3,894.
Accumulated Salaries and Wages To Date	$	41,604.

/2/75

20.0008

Fourth Quarterly Progress Report to NCHRP December 31, 1978

Project 4-14 FY'78: Coating Systems for Painting Old and New Structural Steel (Georgia Tech A-2092)

I. Objective

The objective is the preparation of guidelines for the use of existing and recently developed non-proprietary coating systems for the painting of structural steel with emphasis on such considerations as:

(a) health and environment

(b) exposure condition

(c) application requirements

(d) economics

II. Progress Toward Completion

The laboratory work plan has been revised to more closely fit the needs of the whole country while maintaining our emphasis on marine exposure. Bridges near salt water were taken as the most demanding for coating system performance but our exposure panel series will now include more alternative pigments in alkyds and coatings for possible use over brush blasted and wire brush cleaned deteriorated paint. These changes evolved in our September Quarterly Progress Report and in two revisions, October 24 and November 10, 1978. Minor changes also follow in this report.

The questionnaire to state DOT's and other members of AASHTO Operating Subcommittee on Materials was specifically brought into focus by a cover letter request by K. W. Henderson, Jr., Program Director for the Transportation Research Board. At this writing, 24 replies have been received.

Excellent specimens of "old steel" have been cut from a 1958 highway bridge beam for us by the Georgia DOT. The beam was replaced in Atlanta in August, 1978 during construction for MARTA, Atlanta's new rapid transit system. Some panels will represent 20 year old paint, still intact, needing a refresher coat and others, showing considerable rust and underfilm corrosion lifting the paint, will be wire brushed to test new systems for economical refinishing in inland service. Those will be cleaned and coated to two paint thicknesses and exposed on test racks in the Atlanta area.

Most of the test paints have been prepared in our laboratory and all primers have been applied, all by spray. To insure proper drying before exposure to the marine environment, it will be toward the end of January before all the panels are on the racks at Brunswick, Georgia

III. Progress by Phase

Task 1.1 Selected articles have been collected which we are abstracting for updating the 1969 NCHRP Report 74A. Collecting continues from current literature.

Task 1.2 24 replies have been received, as of December 20, to our questionnaire to state DOT's mailed November 3rd. A preliminary review shows the growth of zinc-rich primers and a growth in the use of vinyls for long range economy. Recognition of the value of better surface preparation also is evident.

Task 1.3 Paint manufacturers have not been forthcoming with non-proprietary formulations although their recommendations are helpful when applied to the generic type. Raw material suppliers have been most cooperative in furnishing "starting formulae" that is the foundation of our work in Phase 2.

Task 1.4 SSPC and NACE committees give strong support to our programs.

Task 1.5 The State-of-the-Art-Report is extended throughout the life of the contract.

Phase 2 Experimental Evaluation of Recently Developed Systems

The attached annotated Table 1 from our last Quarterly Progress Report as revised November 10 summarizes our plan for Phase 2. We have added 6 more pairs of panels, S36 through S40, which are the same coating systems as S23 through S28c on new "White" steel. For the control alkyd panels we have submitted Ga. DOT 870.02 No. 1C and 3A. The primer is AASHTO M229-74, Type I. In system S23 the topcoat is corrected to read T-7. The Molywhite formulations will use No. 212 in water-borne coatings as shown, but for alkyds we will use Molywhite No. 101 as recommended by the manufacturer. MV-9 will be used instead of MV-23 in System S31 because MV-9 is the Rohm and Haas latex used in the recent 1000 gallon bridge trial by California DOT.

We were trying to have all panels to be exposed on exterior racks in Brunswick and Atlanta in place by the year's end. Now we expect it will be toward the end of January before all will be ready for exposure. Salt spray and weatherometer testing will begin soon thereafter for the accelerated testing.

All of the KTA panels of new steel and the series of alternate pigments in alkyds (S23-528C, S36-S40) are primed. The old flat steel panels will be identified individually and photographed after cleaning and before priming.

Attached is a complete formula sheet for Primer P-12, used in system S24 and S37 as an example of our operating procedures.

SYSTEM	STEEL	CLEAN	PRIMER	TOPCOAT	BRUNSWICK KIA Panels SALT 3-5 mils	6-8 mils	FOG	WEA-O-M
S1	New	White	P1 Inorg Zn	T1 Urethane/TiO_2 (tie)	X	X	X	X
S2	New	White	P1 Inorg Zn	T2 820 Latex/TiO_2	X	X	X	X
S3	New	White	P1 Inorg Zn	T3 Shell Epoxy/TiO_2	X	X	X	X
S4	New	White	P1 Inorg Zn	T4 MV-23 Latex/TiO_2	X	X	X	X
S5	New	White	P1 Inorg Zn	T5 Hi Build Vy/TiO_2	X	X	X	X
S6	New	White	P2 820 Latex/Busan	T2 820 Latex/TiO_2	X	X	X	X
S7	New	White	P3 MV-23 Latex/ZnO	T4 MV-23 Latex/TiO_2	X	X	X	X
S8	New	White	P4 VMCA/$ZnPO_4$	T5 Hi Build Vy/TiO_2	X	X	X	X
S9	New	White	P5 Mil-Epoxy	T1 Urethane/TiO_2	X	X	X	X
S10C	New	White	P6 Alkyd/Lead pigt	T6 Alkyd/lead pigt	X	X	X	X
S11	New	White	P7 820 Latex/Nalzin	T2 820 Latex/TiO_2	X	X	X	X
S12	New	White	P8 820 Latex/Mb-212	T2 820 Latex/TiO_2	X	X	X	X
S13	New	White	P9 820 Latex/Halox	T2 820 Latex/TiO_2	X	X	X	X
S14	New	White	P9 820 Latex/Halox	T10 820 Latex/Al paste	X	X	X	X
S15	New	White	P9 820 Latex/Halox	T11 820 Latex/Mic-Fe_2O_3	X	X	X	X
S16	New	White	P10 H_2O cure PU/TiO_2	T1 Urethane/TiO_2	X	X	X	X
S17	Old	Brush	Old intact alkyd/lead	T1 Urethane/TiO_2	X	X		
S18	Old	Brush	Old intact alkyd/lead	T2 820 Latex/TiO_2	X	X		
S19	Old	Brush	Old intact alkyd/lead	T3 Shell Epoxy/TiO_2	X	X		
S20	Old	Brush	Old intact alkyd/lead	T4 MV-23 Latex/TiO_2	X	X		
S21	Old	Brush	Old intact alkyd/lead	T5 Hi Build Vy/TiO_2	X	X		
S22C	Old	Brush	Old intact alkyd/lead	T6 Alkyd/lead pigt	X	X		
					GEORGIA TECH CAMPUS			
S23	Old	Hard Rust	P11 alkyd/Busan	T7 alkyd/Busan	X	X		
S24	Old	Hard Rust	P12 alkyd/ZnPO	T12 alkyd/ZnPO	X	X		
S25	Old	Hard Rust	P13 alkyd/Nalzin	T13 alkyd/Nalzin	X	X		
S26	Old	Hard Rust	P14 alkyd/Mb-101	T14 alkyd/Mb-101	X	X		
S27	Old	Hard Rust	P15 alkyd/Halox	T15 alkyd/Halox	X	X		
S28C	Old	Hard Rust	P6 alkyd/lead	T6 alkyd/lead	X	X		
S29	Old	Hard Rust	P15 alkyd/Halox	T10 820 Latex/Al paste	X	X		
S30	Old	Hard Rust	P15 alkyd/Halox	T11 820 Latex/Mic-Fe_2O_3	X	X		
S31	Old	Hard Rust	P15 alkyd/Halox	T16 MV-9 /Al paste	X	X		
S32	Old	Hard Rust	P15 alkyd/Halox	T17 MV-23/Mic-Fe_2O_3	X	X		
S33	Old	Hard Rust	P15 alkyd/Halox	T18 4358/Al paste	X	X		
S34	Old	Hard Rust	P15 alkyd/Halox	T19 4358/Mic-Fe_2O_3	X	X		
S35	Old	Hard Rust	P10 H_2O cure PU/TiO_2	T1 Urethane/TiO_2	X	X		

* S36-S40 same but on new steel

ct: A-2092 t: GA. DOT - 1C Orange Primer			BATCH SIZE 100 Gals. (if pounds) 5/6 qt.-lab		TANK NO.	BATCH NO. P-6 LH-2
ms NDS)	(GALLONS)	MATERIAL	UNIT PRICE	COST		EXP. NO.
2.8	14.50	TT-R-266-Type I				Air Dry: ~~XXX~~
8.3	7.00	Bentone 38/MS				Application: Spray - ok
1.7	.25	Methanol				
		Blend 5 min.				Reduction: None
2	.25	Lecithin				
50	30.79	M-50				Thinner: None
		Disperse (Grind to 4+N.S.)				
.9	41.50	Raw Linseed Oil				Cautions: Standard
.0	.25	6% Cobalt				
.4	.25	24% Lead				
.0	.50	6% Manganese				
.0	.25	Anti-Skinning Agent				Visc: 70-75 K.V.
.7	5.75	R/66 Mineral Spirits				Wt./Gal: 14.8 min.
.8	101.29					Grind: 4 +
						Gloss: N/A
						Dry: 18 Hrs.
	Pig-% by Wt.	- 66.7				pH: N/A
	Ven-% by Wt.	- 33.3				Red Label ☐ Yes ☐ No
	M-50% by Wt.	- 99.3				Flash Point °F:
	B-38% by Wt.	- .7				OK'd By:
	NVV - % by Wt.	- 76.2				Date:
/Driers	- % by Wt.	- 23.8				
	PVC - % by Wt.	- 38.2				Hiding: O.K.
al Solids	% by Wt.	- 91.6				Formulator: LEH
						Date: 11-29-78
						RMC:
		Mixer:				Cost/Gal:
		Time in Lab:				Fill:
		Time out Lab:				
		TOTALS				Yield:

A-2092

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

January 26, 1979

Mr. Harry A. Smith
Project Engineer - NCHRP
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Re: Report of January 1979 on NCHRP 4-14, FY '78, Ga. Tech A-2092
"Coating Systems for Painting Old and New Structural Steel"

Dear Harry:

Enclosed are 3 copies of our January monthly progress schedule. You have the copy of my notes prepared for the January 17 presentation at the TRB annual meeting. Since then we have also received an answer from the Georgia and New Jersey DOT.

I hope you can arrange for some kind of a reminder to motivate the remaining eleven. Attached is a copy of Mr. Hay's reply. Bernie Appleman said we should not expect them to answer the questionnaire for the District of Columbia.

I enjoyed my two days at the TRB meeting and feel it will enhance our work on this project. Naturally, I am disappointed that I could not tell our story. Next time I will have the essence of my remarks on slides to show with appropriate speed.

Sincerely,

Frank A. Rideout
Acting Principal Investigator

FAR:dm
Enclosure(s)

NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

P Project No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL Fy 78 Month Jan. 1979

ch Agency Georgia Tech Research Institute (Engineering Experiment Station

al Investigator Frank A. Rideout (Acting) (Telephone: 404-428-9053)

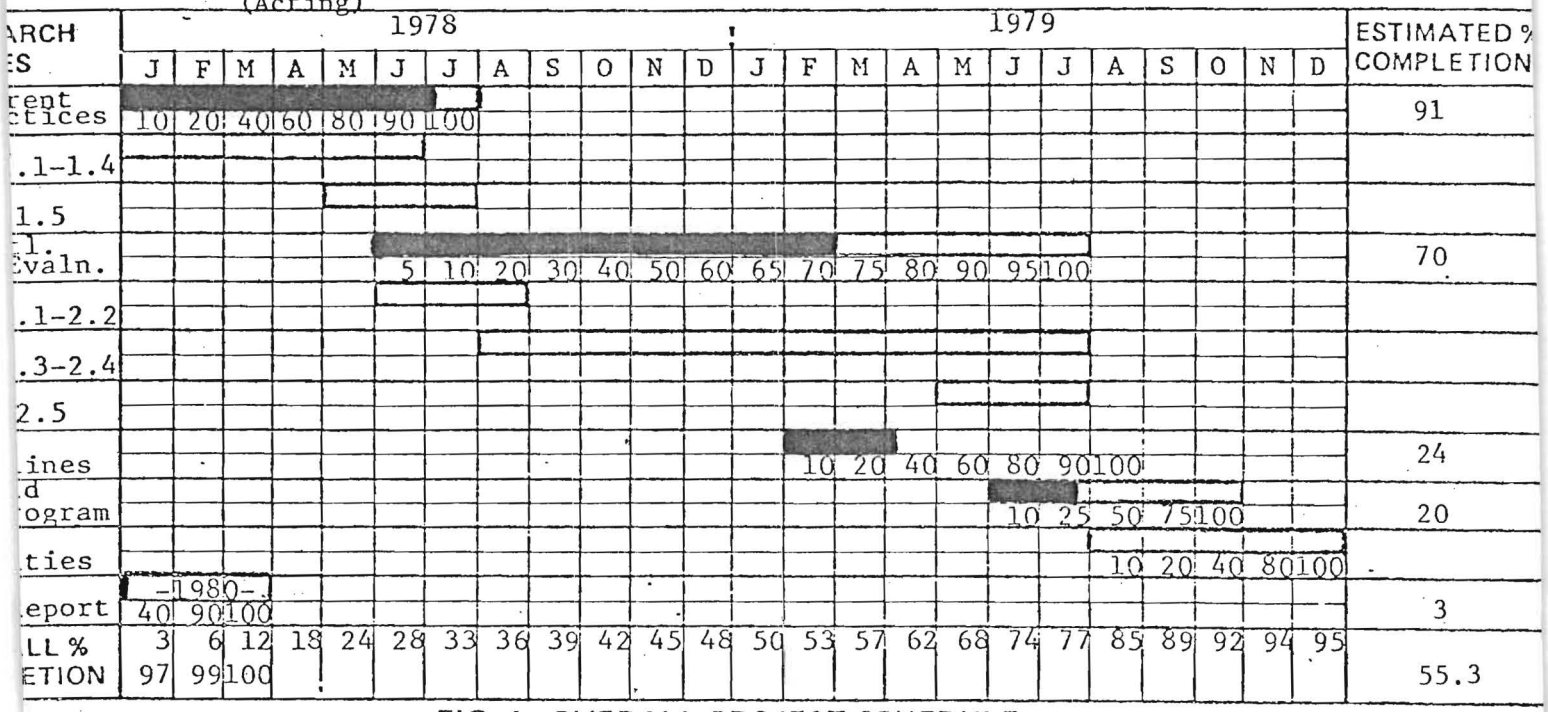


FIG. A—OVERALL PROJECT SCHEDULE

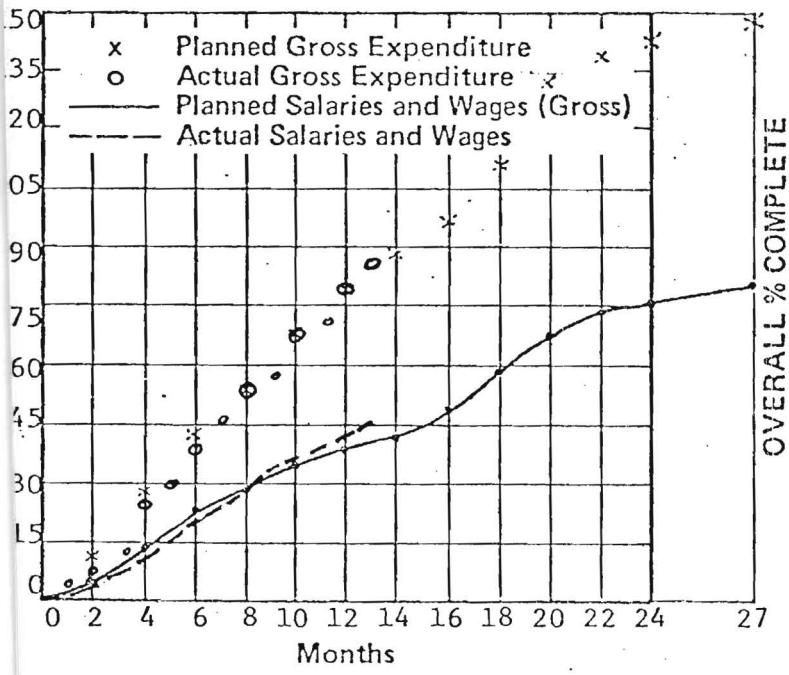


FIG. B—CONTRACT FUNDS

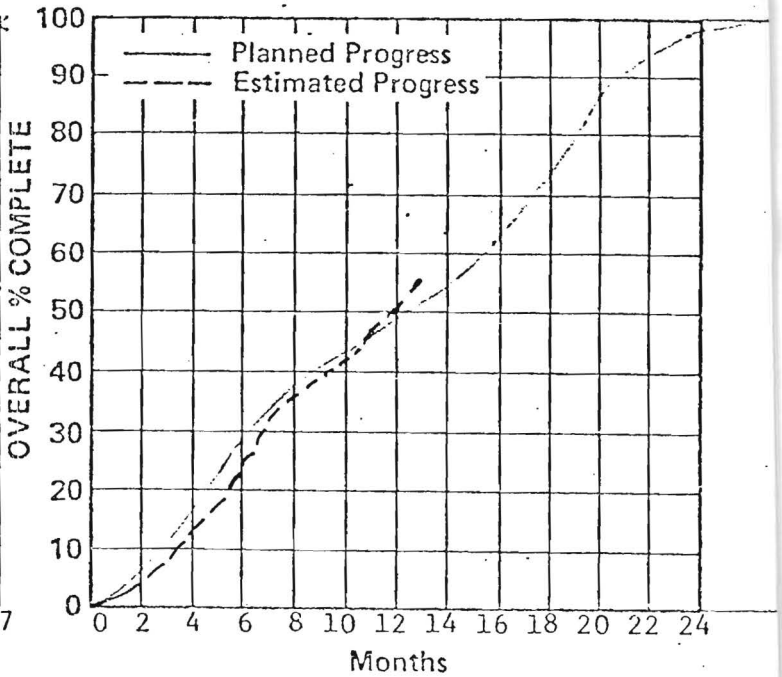


FIG. C—CONTRACT PERIOD

Funds Expended	% 58.4
Contract Amount	$ 149,231
Expended this Month	$ 7,719
Total Exp. To Date	$ 87,183
Balance	$ 62,048

Time Expended %	56.9
Starting Date	January 1, 1978
Completion Date	March 31, 1980

Salaries and Wages Estimated This Month	$ 2,888
Salaries and Wages Spent This Month	$ 3,804
Accumulated Salaries and Wages To Date	$ 45,435

'2/75

20.0008

A-2092

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

February 26, 1979

Mr. Harry A. Smith, Project Engineer
NCHRP
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Re: February 1979 Report, NCHRP 4-14, FY'78. Ga. Tech A-2092 "Coating Systems for Painting Old and New Structural Steel"

Dear Harry:

Enclosed are 3 copies from February monthly progress schedule for NCHRP 4-14.

Since you received our notes for the January 17 TRB presentation, we have answers also from Georgia, New Jersey and Oregon.

We will appreciate your assistance to encourage the remaining 10 to send theirs in too.

February 13 I met with Joe Raska and Donnie Kilgore in Austin and discussed their questions and comments to the satisfaction of all. Joe would like to have had us do more work with rusty steel, various other levels of surface preparation and with organic zinc-rich and urethane primers but understands we are now committed in our experimental work. He was especially helpful in explaining how to correct "mud-cracking" of zinc-rich coatings and how wind velocity effects corrosion.

February 14 I visited Al Dunn at Baton Rouge (DOT) and learned of his experience with vinyls, zinc-rich primers and new urethanes. No one has a complete set of answers but we seem to be working along similar lines. Al offered a wealth of case histories for when we can study the performance.

February 19 and 20 we put 84 KTA panels on exposure at Brunswick. We plan to make our first inspection March 19 and put out some repainted old steel systems.

Sincerely,

Frank A. Rideout
Acting Principal Investigator
Chemical and Material Sciences Division

FAR:dm
Enclosure(s)

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

Project No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL Fy' 79 Month February '79
Agency Georgia Tech Research Institute (Engineering Experiment Station
Investigator Dr. Daniel J. O'Neil (Telephone: 404-894-3095) Frank Rideout, Act. in PI

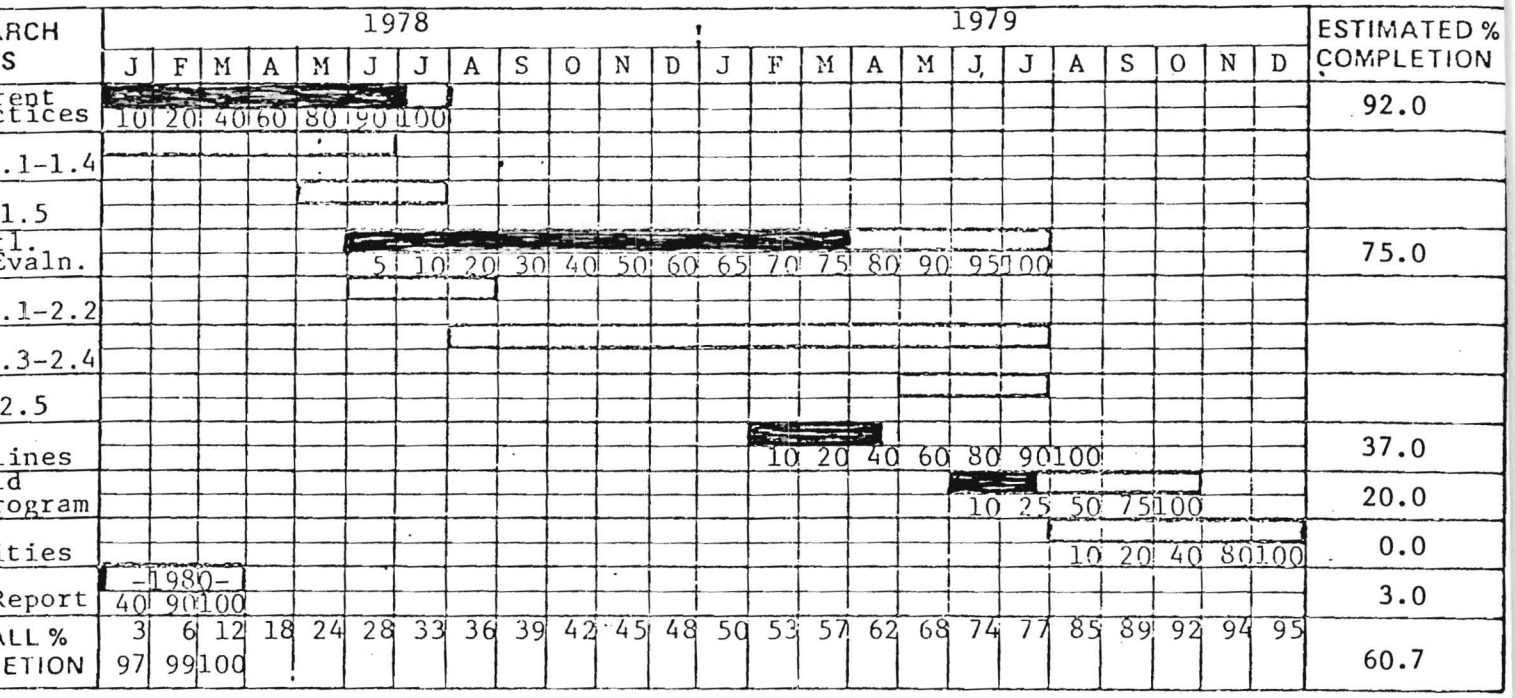


FIG. A—OVERALL PROJECT SCHEDULE

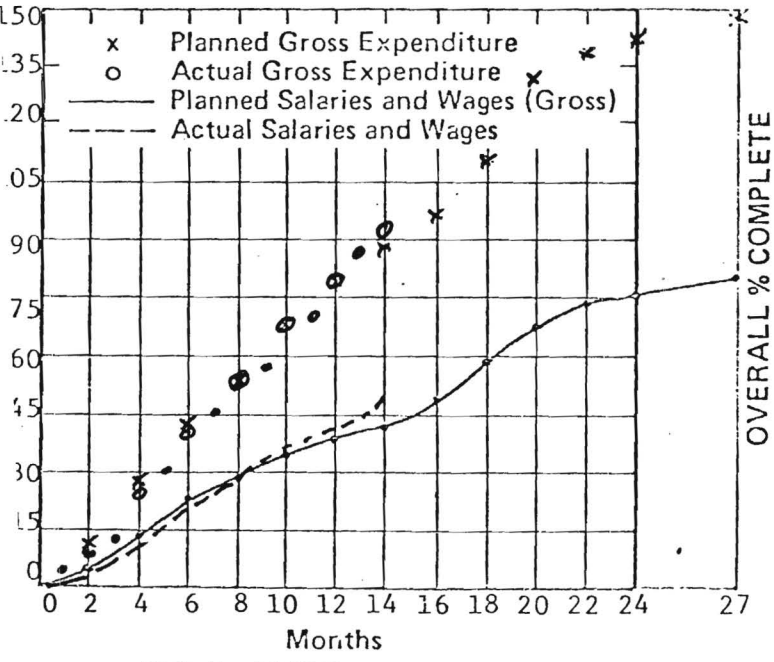


FIG. B—CONTRACT FUNDS

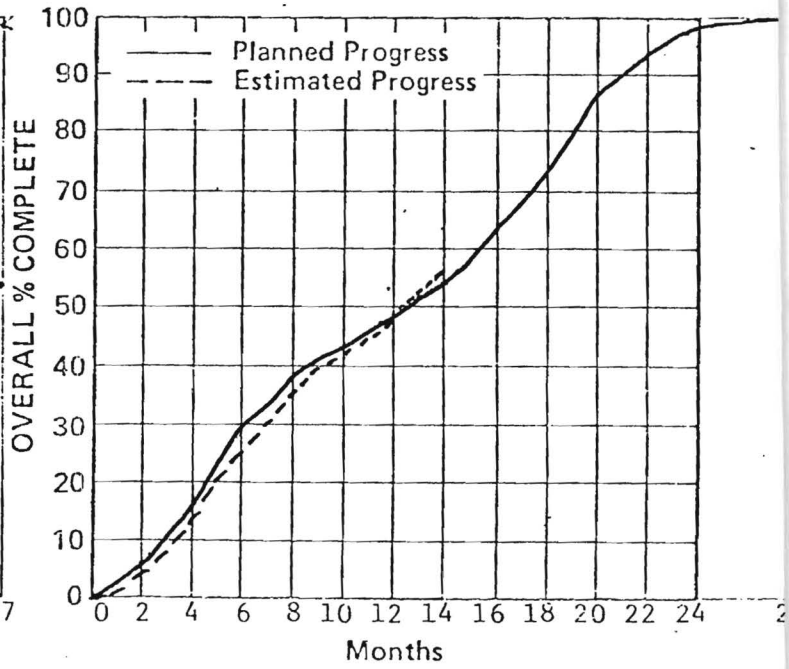


FIG. C—CONTRACT PERIOD

Funds Expended	%	62.5
Contract Amount	$	149,231
Expended this Month	$	4,555
Total Exp. To Date	$	93,208
Balance	$	56,023

Time Expended %	56.9
Starting Date	January 1, 1978
Completion Date	March 31, 1980

Salaries and Wages Estimated This Month	$ 2888
Salaries and Wages Spent This Month	$ 3317
Accumulated Salaries and Wages To Date	$ 49,148

QUARTERLY PROGRESS REPORT

to the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

on Project

NCHRP 4-14 FY'79

Coating Systems for Painting Old and New Structural Steel

for period

Jan. 1, 1979 to March 31, 1979

from

Frank A. Rideout, Acting Principal Investigator
Senior Research Scientist
Chemical and Material Sciences Division
Technology and Development Lab
Engineering Experiment Station
Cobb County Research Facility
Atlanta, Georgia 30332

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

Project No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL FY' 78 Month March '79
h Agency Georgia Tech Research Institute (Engineering Experiment Station
l Investigator Frank A. Rideout (Acting)

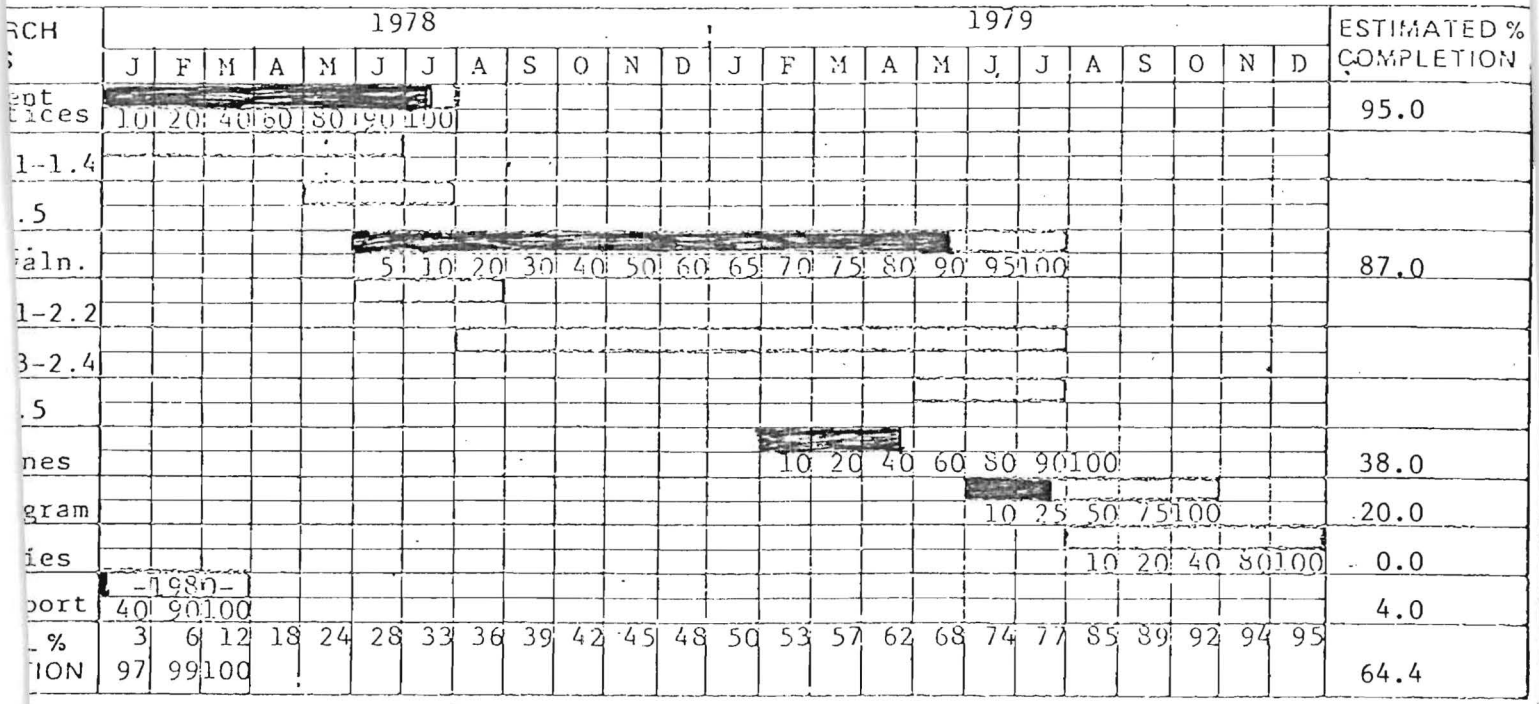


FIG. A--OVERALL PROJECT SCHEDULE

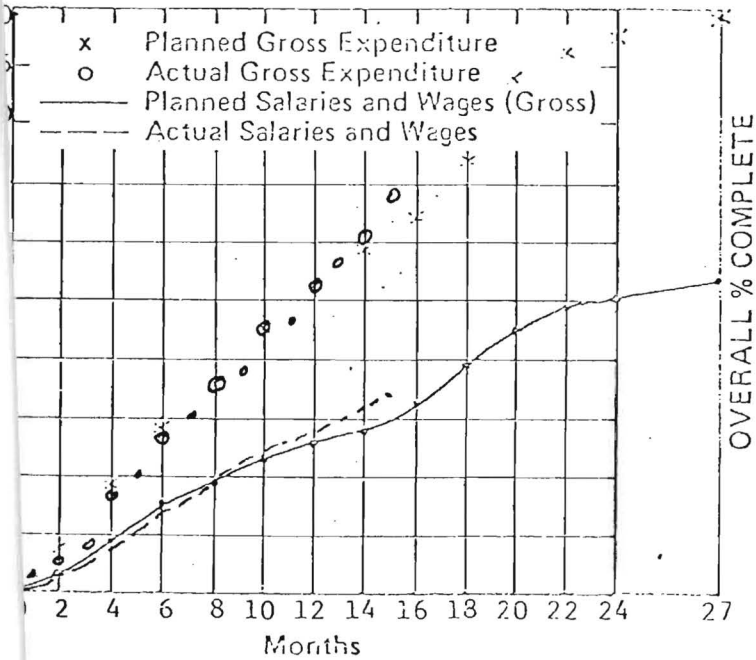


FIG. B--CONTRACT FUNDS

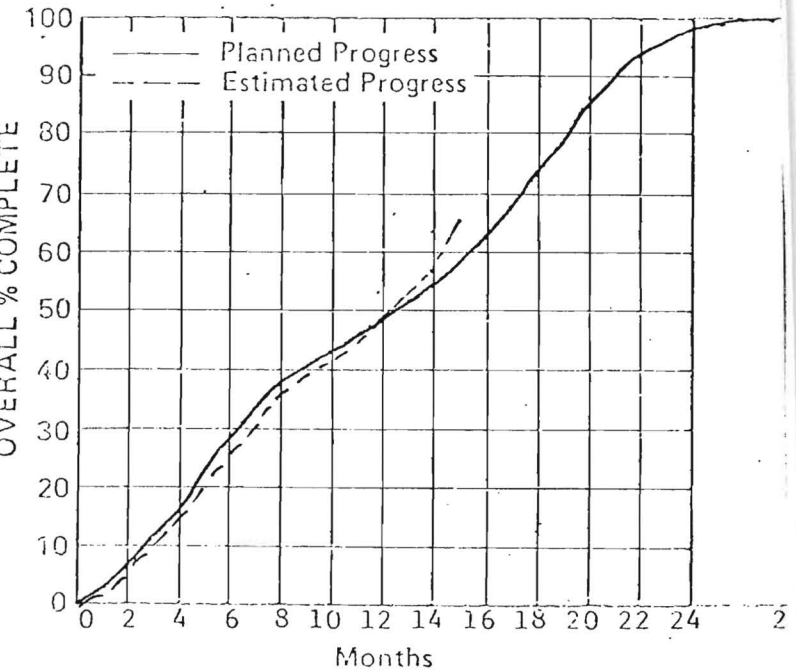


FIG. C--CONTRACT PERIOD

Funds Expended	% 68.2
Contract Amount	$ 149,231
Expended this Month	$ 7,059
Total Exp. To Date	$ 101,860
Balance	$ 47,371

Time Expended %	65.7
Starting Date	January 1, 1978
Completion Date	March 31, 1980

Salaries and Wages Estimated This Month	$ 2,888
Salaries and Wages Spent This Month	$ 3,395
Accumulated Salaries and Wages To Date	$ 52,417

Fifth Quarterly Progress Report to NCHRP March 31, 1979

Project 4-14 FY'78:

COATING SYSTEMS FOR PAINTING OLD AND NEW STRUCTURAL STEEL

Ga. Tech Project A-2092

I. Objective

The objective is the preparation of guidelines for the use of existing and recently developed non-proprietary coating systems for the painting of structural steel with emphasis on such considerations as:

(a) health and environment

(b) exposure condition

(c) application requirements

(d) economics

II. Progress Toward Completion

All exterior panels in our plan have been prepared and put on test racks at Brunswick and on Ga. Tech campus. KTA panels (88) were put out February 20th, and 20 year old steel cut into 12 x 12" panels (81) from a Georgia bridge beam were coated according to our plan and put out March 19 (Brunswick) and March 21 (Georgia Tech).

Service experience and possible guidelines for the various systems have been discussed again with state engineers and suppliers with special help from Texas, Louisiana, Georgia, and Florida DOT's and Mobay, NL Industries, Mobile Paint, Rohm and Haas, and Union Carbide.

In the survey of the state DOT's to update the NCHRP Report 74B on "Protective Coatings for Highway Structural Steel" we have now received 42 replies.

III. Progress by Phase

Phase 1. Current Practices

All states have replied to the attached November letter signed by K.W. Henderson, Jr. Program Director, NCHRP, with the attached questionnaire. A summary of the 42 replies received to date follows with a tabulation of the replies appearing in the first row of boxes.

By April 15 we will try to make telephone contact with the states of Alabama, Alaska, Delaware, Florida, Hawaii, Massachusetts, Mississippi and Wyoming to encourage their replies.

Phase 2. Experimental Evaluation of Recently Developed Systems

All of the panels planned for exterior exposure at the marine site in Brunswick and the inland site on Georgia Tech's campus are completed and in place. An additional S41 set was made with a different filler (T-8) and an additional S40 set made with late MV-9/aluminum paste similar to T16 used in S3 to allow a comparison with the recent California bridge trial of 1000 gallons of such a system.Alternate pigments were also applied to new KTA's.

Shown in the attached revised Table 1 are all the panel systems S1 through S41. There are 3 surface preparations: 1) White metal sandblast, 2) light brush blast and handwire brush to clean and roughen intact paint and 3) brush blast to remove only loose rust leaving hard rust and mill scale.

There are 15 primers and 19 topcoats used in 36 combinations plus 6 of the topcoats are applied over cleaned old intact paint as a one paint refinish. All paint systems were sprayed at 2 thicknesses. All systems were coated in duplicate except S40. The control was Georgia DOT specification 870.02- 1C primer and 3A topcoat. They were used three times, once on each of the surface preparations including the intact old paint when just the

topcoat was applied. These control panels were prepared at two paint thickness and in every case in duplicate. A total of 166 variations on 139 panels are on exposure: 88 new KTA panels and 78 variations on 51 panels of "old" steel.

Attached is a sample cost calculation using as an example the formula shown in our December 1978 Monthly Progress Report. The second page of the calculation shows how we will arrive at cost data for our cost/performance analysis in generating guidelines in our final report.

Phase 3. Tentative Guidelines for Selection and Application of Coating Systems

Data from our survey will be useful in the preparation of our tentative guidelines due by September of this year.

Phase 4. Design of a Field Evaluation Program

Consistent with these guidelines our design will not be a radical departure from the trials now underway in several states. Solvent types and amounts and pigment selection will be in compliance with expected near-term regulations. Performance should not be disappointing if surface preparation and application specifications are honored.

Phase 5. Guideline Revisions and Research Priorities

To begin in August.

IV. Future Task Schedule

By April 15 the 8 remaining state DOT contacts will be made and all replies will be further analyzed.

Abstracts will be prepared of the most significant articles from our continuing literature survey and used to build our tentative guidelines as well as the final report on the state of the art. Steel panels for laboratory testing are now being prepared for the salt spray and weatherometer.

The next inspection of test panels at Brunswick is scheduled for April 23. (63 days exposure should show any major defects at this windy marine location).

NATIONAL RESEARCH COUNCIL

COMMISSION ON SOCIOTECHNICAL SYSTEMS

2101 Constitution Avenue Washington, D. C. 20418

ISPORTATION RESEARCH BOARD

November 3, 1978

Chairman and Members, AASHTO Operating Subcommittee on Materials

JECT: National Cooperative Highway Research Program
Project 4-14, FY '78
"Coating Systems for Painting Old and New Structural Steel"
Georgia Institute of Technology

The objective of the subject project is the preparation of tentative guidelines the use of existing and recently developed nonproprietary coating systems for painting of structural steel, with emphasis on such considerations as (a) health l environment, (b) exposure conditions, (c) application requirements, and (d))nomics. Work on the project will include the updating of current practices as scribed in NCHRP Report 74 prepared by the Steel Structures Painting Council and accelerated testing program using recently developed coating systems.

A 6 item questionnaire and copies of the appropriate portions of Tables 8 and from Report 74B are enclosed.

Success of the project will be substantially aided by your assistance in pro-ding the following information:

1. Response to the questionnaire.

2. Copy of current specifications covering materials, surface preparation, and painting of structural steel.

3. Reports and information on coating systems covered by research, field trials, or other experience since Report 74B that are not included in current specifications.

All information should be sent directly to:

Mr. Frank A. Rideout
Principal Investigator, NCHRP Project 4-14
Chemical and Materials Sciences Division
Engineering Experiment Station
Georgia Institute of Technology
Atlanta, GA 30332

Many thanks for your continued interest and support of the program.

Sincerely,

K. W. Henderson, Jr.
Program Director

Jr:kl
losures

QUESTIONNAIRE

NCHRP Project 4-14 "Coating Systems for Painting Old and New Structural Steel"

1. Have there been any changes in your state's coating specifications for highway bridges since the NCHRP 74B report (see attachment for reference)? If so, please indicate what changes have been made.

2. If changes have been made in your state's coating specifications, why were these changes made?

3. Does your state use a zone system to classify exposure conditions and select appropriate surface preparation and coating systems? Describe.

4. What impact have new environmental and safety regulations had on the selection of coating systems and practices in your state?

5. What aspect of the coating operation is the most critical for achieving a durable system?

6. What area of bridge painting needs the most research or revision of specifications?

STATE	1. CHANGES?	2. WHY?	3. ZONES?	4. REG. EFFECT CTG.?	5. MOST CRITICAL	6. RESEARCH NEEDS?
42 Replies	Yes: 37 (88%) SB: 21 (50%) Zinc:13 (31%) Vinyl:12 (29%) A-588: 7 (17%)	Longer life 23 (55%) Regulations: 12 (29%) Fast dry: 5 (12%)	7 (17%)	Yes: 15 (36%) Minimal: 4 (10%)	Surface Prep. 36 (86%) Application: 16 (38%)	Material: 22 (52%) Inspection: 6 (14%) Regulations: 13 (31%) Surface Prep: 16 (38%) Water-borne: 4 (10%)
Abbreviations	SB - Sandblasting OZ - Organic Zinc IZ - Inorganic Zinc PU - Polyurethane Pb - Lead Reg - Regulations W-B - Water-borne					
Arizona	No	---	No	No	No knowledge	No suggestion
Arkansas	Yes: Zn, SB, Vinyl	Easy application Fast dry	No	No	Surface preparation; Thickness	Chalk, weather, color stability
California	Yes: Vinyl	Rule 66 - No Pb	2	After 9/82 only Zn, W-B, HiS	Surface preparation	Prepare for September 1982
Colorado	0	0	0	0	Surface preparation	Materials Stability
Connecticut	Yes: SB dry thicker chromates, vinyl	Application problems	No	None	Surface preparation Applications of Primer	Surface preparation Repainting

Idaho	Yes: Zn, SB, M-50 Yes: HS Weathered Steel	Available Lower Cost	0 Use Zn in North	0 W-B tests	Edges and Corners Relates to type	0
Illinois	Yes: M-50	Performance (re: NY)	0	0	Surface preparation	PACE (Zn^{o} Poor Application)
Indiana #1	0	0	0	Surface prep.		New Coating/Surf. Prep.
Indiana #2	Yes: Vinyl	Longer Life	0	No	Surface preparation	Compliance; guidelines
Iowa	Yes: IZ, Vinyl	No Pb, longer life	0	No Pb & SB to be limited	Surface preparation	Durable/Environment OK
Kansas	Yes: IZ, Vinyl	Longer life	0	No	Surface preparation; Application	W-B
Kentucky	Yes: SB, Al	No Pb, adhesion	---	Cost = 3X	Cleaning	Shoes, Rockers, External Dams
Louisiana	Yes: OZ	Pollution	0	No Pb	Surface preparation; Application	Generic specs, PU
Maryland	Yes: M-50, Zn, Vinyl	life and Color change	0	Yes, No Pb	Surface preparation	Profile and application

STATE	1. CHANGES?	2. WHY?	3. ZONES?	4. REG. EFFECT CTG.?	5. MOST CRITICAL	6. RESEARCH NEEDS?
Michigan	Yes: ASTM/A-588 Steel	Cost effective;	No	No; Research for Non-proprietary IZ	Cleaning	Conformance
Minnesota	Yes: OZ	No Pb, longer life	No	Minimal	Surface preparation; Application	Edge coating; Wash Primer
Missouri	Yes.	No Pb	0 (IZ In	Yes	Surface preparation	Non proprietary for regulations and durable, apply easy and minimum surface preparation
Montana	Yes: M-50, Zn, PO_4	Less water soluble	No	No	Surface preparation	None
Nebraska	Yes: pigments	Some no Pb	No	Yes	Surface preparation solution	Cleaning, no Pb
Nevada	Yes: Vinyl	Convenience	0	None	Cleaning, application	No
New Hampshire	Yes: ASTM/A-588; M-50, Hot Vinyl over oil					
New Mexico	No	---	No	None	Material quality and application	Metal Temperature
New York	Yes: (OSHA)	Regulations	---	Yes	Cleaning	---

STATE	1. CHANGES?	2. WHY?	3. ZONES?	4. REG. EFFECT CTG.?	5. MOST CRITICAL	6. RESEARCH NEEDS?
North Carolina	Yes: Zn Weather Steel inland	Longer life Shop application OK EPA	Coastal and inland	Yes	Mixing application, thinning, temperature, humidity, thickness	Training Program
North Dakota	Yes: alkyd	More colors	No	No	Surface preparation	EPA Regulations
Ohio	Yes	Better protection and cost	No	Difficult to SB	Cleaning	Compliance, easy application
Oklahoma	Yes: M-50	Use new materials	No	No	Surface preparation; Application	New Coatings
Pennsylvania	Yes	Longer life, color	0	0	Surface preparation; Application - Inspection	Non-polluting cleaning, longer life and data to justify cost
Rhode Island	No	----	No	No	Shop Coat	Service life
South Carolina	Yes: IZ, Vinyl, Epoxy	Longer life	No	None	Surface preparation and primer	Cost effective
South Dakota	No	---	No	None	Surface preparation, thickness	
Tennessee	Yes: IZ, HiS, Vinyl, SB, Weathered Steel	Fast dry, fewer coats	No	Minimal	Cleaning	Recoating

STATE	1. CHANGES?	2. WHY?	3. ZONES?	4. REG. EFFECT CTG.?	5. MOST CRITICAL	6. RESEARCH NEEDS?
Texas	Yes: Cleaning and application	Upgrade	Coated and other	Minimal	Surface preparation	W-B; Education
Utah	Yes: SB, M-50, thicker	Longer life	No	No Pb	Surface preparation and primer	
Vermont	Yes: M-50, alkyds	Performance	No	No Pb; EPA	Surface preparation	Cost effective coatings. Meeting regulations, Surface preparation guidelines.
Georgia	Yes: SB, no mill scale	Better preparation	No	No	Preparation and application	Coatings to meet regulations
Oregon	Yes: $ZnCrO_4$ M-50, control steel temp	Use less lead; better control	Yes: 5	Yes, no red lead collect residue	Application	High performance coatings easy to apply. Qualify painters.
New Jersey	Yes: M-50	Improved corrosion resistance	Yes: NCHRP Report 74 Zones for new steel	None	Surface preparation	Alternate coating and preparation surface.
Maine	Yes: M-50 A-588 Steel	Environment Red lead not available	Yes: 2	Yes	Cleaning, application and protection during construction (1 year)	Field application and touch up especially with high humidity and low temperatures.
Virginia	Yes: some alkyd, IZ Vinyl	Fast dry, longer life	No	None	Surface preparation and inspection	Compliance, surface preparation
Washington	Yes: M-50, Zn, WP, phenolic	Fast dry, longer life, no Pb cost	No	None	Surface preparation	W-B
West Virginia	Yes - SB, Vinyl, IZ Thicker films	Research findings	No	Some	Surface preparation	Surface preparation and inspection
Wisconsin	Yes: Surface condition - 3 coats now 4 ASTM/A-588 Steel	Durability	No	No spray or SB over water...little Pb, Cleaning: Hand = 9 yrs/SB - 20 years	Cleaning application conditions	Non-toxic durable coatings no/SB

S1	New	White	P1 Inorg Zn	T1 Urethane/TiO_2 (tie)	X	X	X	X
S2	New	White	P1 Inorg Zn	T2 820 Latex/TiO_2	X	X	X	X
S3	New	White	P1 Inorg Zn	T3 Shell Epoxy/TiO_2	X	X	X	X
S4	New	White	P1 Inorg Zn	T4 MV-23 Latex/TiO_2	X	X	X	X
S5	New	White	P1 Inorg Zn	T5 Hi Build Vy/TiO_2	X	X	X	X
S6	New	White	P2 820 Latex/Busan	T2 820 Latex/TiO_2	X	X	X	X
S7	New	White	P3 MV-23 Latex/ZnO	T4 MV-23 Latex/TiO_2	X	X	X	X
S8	New	White	P4 VMCA/$ZnPO_4$	T5 Hi Build Vy/TiO_2	X	X	X	X
S9	New	White	P5 Mil-Epoxy	T1 Urethane/TiO_2	X	X	X	X
S10C	New	White	P6 Alkyd/Lead pigt	T6 Alkyd/lead pigt	X	X	X	X
S11	New	White	P7 820 Latex/Nalzin	T2 820 Latex/TiO_2	X	X	X	X
S12	New	White	P8 820 Latex/Mb-212	T2 820 Latex/TiO_2	X	X	X	X
S13	New	White	P9 820 Latex/Halox	T2 820 Latex/TiO_2	X	X	X	X
S14	New	White	P9 820 Latex/Halox	T10 820 Latex/Al paste	X	X	X	X
S15	New	White	P9 820 Latex/Halox	T11 820 Latex/Mic-Fe_2O_3	X	X	X	X
S16	New	White	P10 H_2O cure PU/TiO_2	T1 Urethane/TiO_2	X	X	X	X
S17	Old	Brush	Old intact alkyd/lead	T1 Urethane/TiO_2	X	X		
S18	Old	Brush	Old intact alkyd/lead	T2 820 Latex/TiO_2	X	X		
S19	Old	Brush	Old intact alkyd/lead	T3 Shell Epoxy/TiO_2	X	X		
S20	Old	Brush	Old intact alkyd/lead	T4 MV-23 Latex/TiO_2	X	X		
S21	Old	Brush	Old intact alkyd/lead	T5 Hi Build Vy/TiO_2	X	X		
S22C	Old	Brush	Old intact alkyd/lead	T6 Alkyd/lead pigt	X	X		
					GEORGIA TECH CAMPUS			
S23	Old	Hard Rust	P11 alkyd/Busan	T7 alkyd/Busan	X	X		
S24	Old	Hard Rust	P12 alkyd/ZnPO	T12 alkyd/ZnPO	X	X		
S25	Old	Hard Rust	P13 alkyd/Nalzin	T13 alkyd/Nalzin	X	X		
S26	Old	Hard Rust	P14 alkyd/Mb-101	T14 alkyd/Mb-101	X	X		
S27	Old	Hard Rust	P15 alkyd/Halox	T15 alkyd/Halox	X	X		
S28C	Old	Hard Rust	P6 alkyd/lead	T6 alkyd/lead	X	X		
S29	Old	Hard Rust	P15 alkyd/Halox	T10 820 Latex/Al paste	X	X		
S30	Old	Hard Rust	P15 alkyd/Halox	T11 820 Latex/Mic-Fe_2O_3	X	X		
S31	Old	Hard Rust	P15 alkyd/Halox	T16 MV-9 /Al paste	X	X		
S32	Old	Hard Rust	P15 alkyd/Halox	T17 MV-23/Mic-Fe_2O_3	X	X		
S33	Old	Hard Rust	P15 alkyd/Halox	T18 4358/Al paste	X	X		
S34	Old	Hard Rust	P15 alkyd/Halox	T19 4358/Mic-Fe_2O_3	X	X		
S35	Old	Hard Rust	P10 H_2O cure PU/TiO_2	T1 Urethane/TiO_2	X	X		

*S36-S39 same but on new steel (KTA panels).

S40 same as S31 using MV-9 (T9).

S41 same as S3 with a different inert pigment (T8).

COST CALCULATION
Paint No. P-6
Batch No. LH-2

Spec. 1C: Orange Primer (Oil/Silico Lead Chromate)

(a) Gallons		Unit Price	Cost (b)	Properties
14.50	TT-R-266-Type I Alkyd Resin	$ .453	$ 51.10	Air Dry
7.00	Bentone 38/Mineral Spirits	.7725	37.31	Application - Spray
.25	Methanol	.165	.28	
	Blend 5 Min.			Reduction - None
.23	Lecithin	.365	.73	
30.79	M-50, Basic lead silicochromate	.6075	637.88	Thinner - None
	Disperse (Grind to 4+N.S.)			
41.50	Raw Linseed Oil	.373	120.44	Cautions - Standard
.25	6% Cobalt Drier	2.63	5.26	
.25	24% Lead Drier	.67	1.61	
.50	6% Manganese	.61	2.44	
.25	Anti-Skinning Agent	1.015	2.03	Viscosity: 70-75 K.V.
5.75	Rule/66 Mineral Spirits	.154	5.65	Wt./Gal. - 14.8 Min.
101.29			$864.73	Grind - 4+
	Paint Composition			
	Raw Material Cost 1 Ga. =	$8.537		Gloss - Not Applicable
	Thinners & Driers % by Wt.	23.8		Dry - 18 Hrs.
	Pigment Volume Concentration (PVC %)	38.2		pH - Not Applicable
	Total Solids % by Wt. of Paint	91.6		
	Pigment % by Wt.	66.7		
	Vehicle % by Wt.	33.3		
	M-50 % by Wt.	99.3		
	Vehicle Composition, % by Weight			
	Non-Volatile Vehicle	76.2		
				Hiding - O.K.
				Date: 11-29-78

nds to make approximately 100 gallons.

ts as of March 26, 1979.

COST CALCULATION (cont'd).
Paint No. P-6
Batch No. LH-2

Spec. 1C: Orange Primer (Oil/Silico Lead Chromate)

Gallons	Solids Only
8.92	TT-R-266-Type I Resin Solids
.40	Bentone 38
.23	Lecithin
30.79	M-50
41.50	Raw Linseed Oil
81.84	gallons (Volume of solids in formula)

$\frac{\text{l. solids}}{\text{l. batch}} = \frac{81.84}{101.29}$ = .808 Gal. of Solids in one Gallon Paint

e Calculation

1 x .808 = 186.6 cubic inches, Solids/Ga.

$\frac{6.6 \times 1000}{144}$ = 1,295.8 Sq. Ft. Coverage at 1 mil Dry Film Thickness (D.F.T.)

assumes average margin for manufacturing costs, freight, packaging, selling, etc., is raw materials, the $8.537 raw material cost/gallon becomes $14.94/gallon contractors

$\frac{\$14.94}{1,295.8}$ = $.0115 Coating Cost Sq. Ft./Mil.

Ga. DOT - Specifies 2 mils dry film thickness for this paint.

Assuming 30% Spray Loss - 2.99¢/sq. ft. @ 2 mils thick

A-2092

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

April 27, 1979

Mr. Harry A. Smith, Project Engineer
NCHRP
Transportation Research Board
2101 Constitution Avenue, N. W.
Washington, D. C. 20418

Re: April 1979 Report, NCHRP 4-14, FY '78. Georgia Tech A-2092
"Coating Systems for Painting Old and New Structural Steel"

Dear Harry:

Enclosed are 3 copies of our April monthly progress schedule for NCHRP 4-14.

Last week we put 64 panels of flat .064 steel, (6" x 12") on the Brunswick racks with the first 16 systems shown in our Table 1 that appears on our last 3 quarterly reports. These panels face south at 45° and serve as a check on the KTA panels. Each system is applied at 2 thicknesses and each in duplicate.

The KTA panels, now exposed two months, all look good except for small application imperfections that have now been corrected. The 12 x 12 x 1/2" old steel panels after a month shows rusting where the panel numbers were punched and both latex systems over the old alkyd show signs of early failure by several red rust spots appearing on the face. Our present plan is to inspect panels monthly unless the report appears to stabilize.

Our contacts with the states that did not reply to the November questionnaire has brought brief replies from Mississippi and Massachusetts. Eight more to go.

Sincerely,

Frank A. Rideout
Acting Principal Investigator
Chemical and Material Sciences Division

FAR:gp

Enclosure(s)

NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

Project No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL FY' 78 Month April,1979

ch Agency Georgia Tech Research Institute (Engineering Experiment Station

al Investigator Frank A. Rideout, Acting Principal Investigator

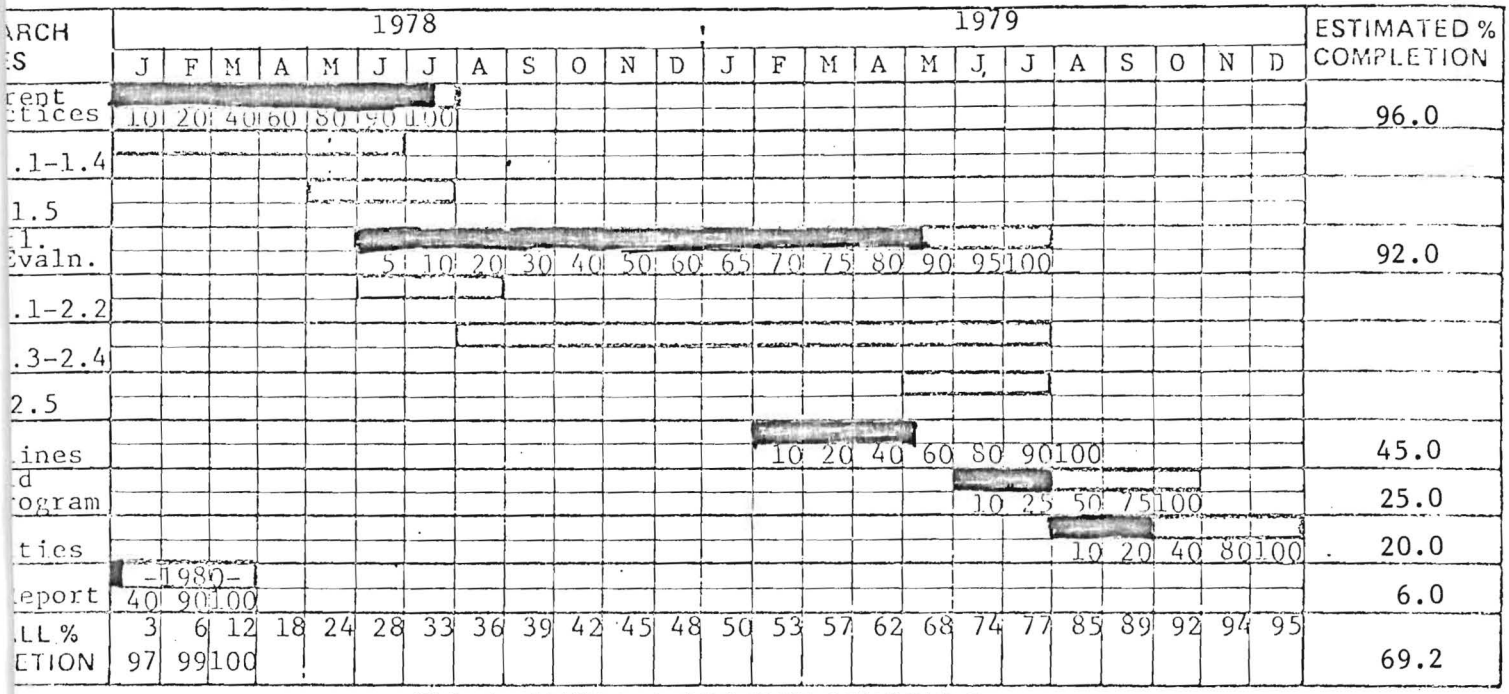


FIG. A—OVERALL PROJECT SCHEDULE

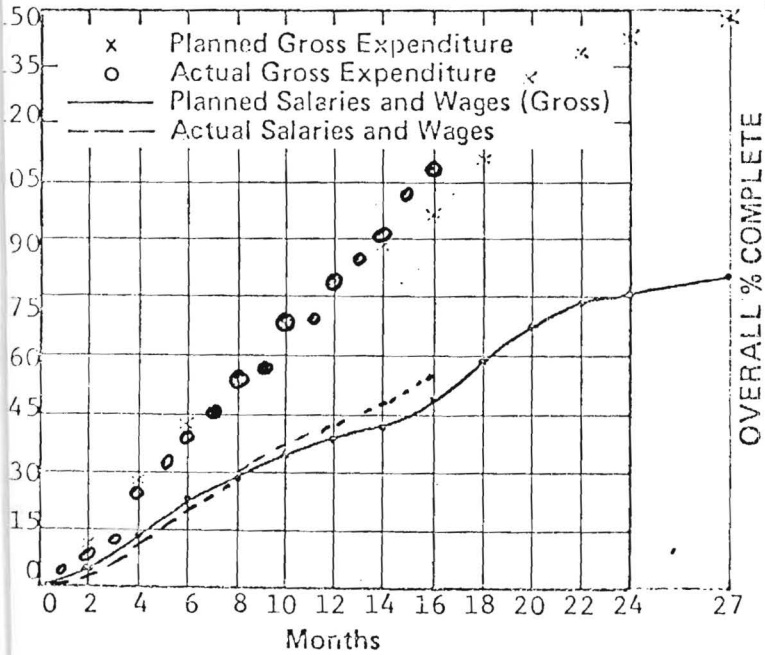


FIG. B—CONTRACT FUNDS

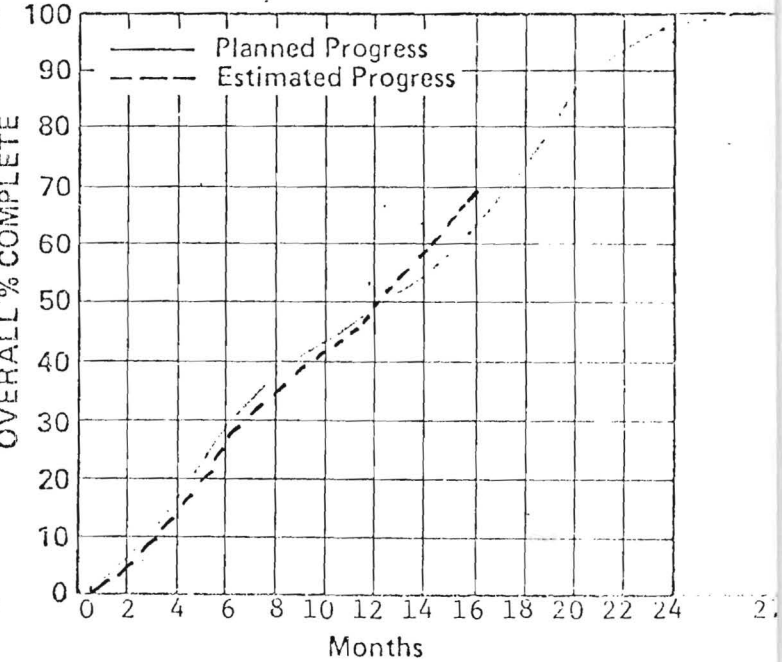


FIG. C—CONTRACT PERIOD

Funds Expended	% 73.4
Contract Amount	$ 149,231
Expended this Month	$ 6,990.00
Total Exp. To Date	$ 109,497.00
Balance	$ 39,734.00

Time Expended %	70.6
Starting Date	January 1, 1978
Completion Date	March 31, 1980

Salaries and Wages Estimated This Month	$ 2888.00
Salaries and Wages Spent This Month	$ 3586.00
Accumulated Salaries and Wages To Date	$ 56342.00

/2/75

20.0008

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

June 8, 1979

Mr. Harry A. Smith, Project
Engineer
NCHRP
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D. C. 20418

Re: May 1979 Report, NCHRP 4-14, FY'78.Ga. Tech A-2092, "Coating Systems for Painting Old and New Structural Steel

Dear Harry:

Enclosed are 3 copies of May monthly progress schedule for NCHRP 4-14.

Laboratory salt spray tests of the 16 systems (all in duplicate) show blistering at 192 hours for System 12 on one panel. At 216 hours blisters appeared on Systems 2, 6, 7, 11, 12, 13 and 15. These all include a latex in the system. Rust has appeared on Systems 3, 4, 6 and 15 in small amounts and Systems 2, 7, 11, 12, 13 and 14 in substantial amounts. System 12 has now failed. The weatherometer samples are all good at over 1000 hours.

Our inspection of panels at Brunswick on May 22 showed essentially no change from our last review.

So we do have tools working to show differences and we plan to do some preliminary analysis of these results for our Quarterly Progress Report next month.

We look forward to our joint visit to Brunswick June 26. I have my reservation on your schedule Atlanta to St. Simons and back which will keep until Paul Hawley's inspection and installation of the second set of KTA panels June 22 turns up a problem.

Sincerely,

Frank A. Rideout
Acting Principal Investigator
Chemical and Material Sciences
Laboratory

FAR:gp

Enclosure(s)

PROJECT SCHEDULE

Project No. 4-14: [illegible] Fy' 78 Month May, 1979

Agency Georgia Tech Research Institute (Engineering Experiment Station)

Investigator ... Frank A. Rideout, Acting Principal Investigator

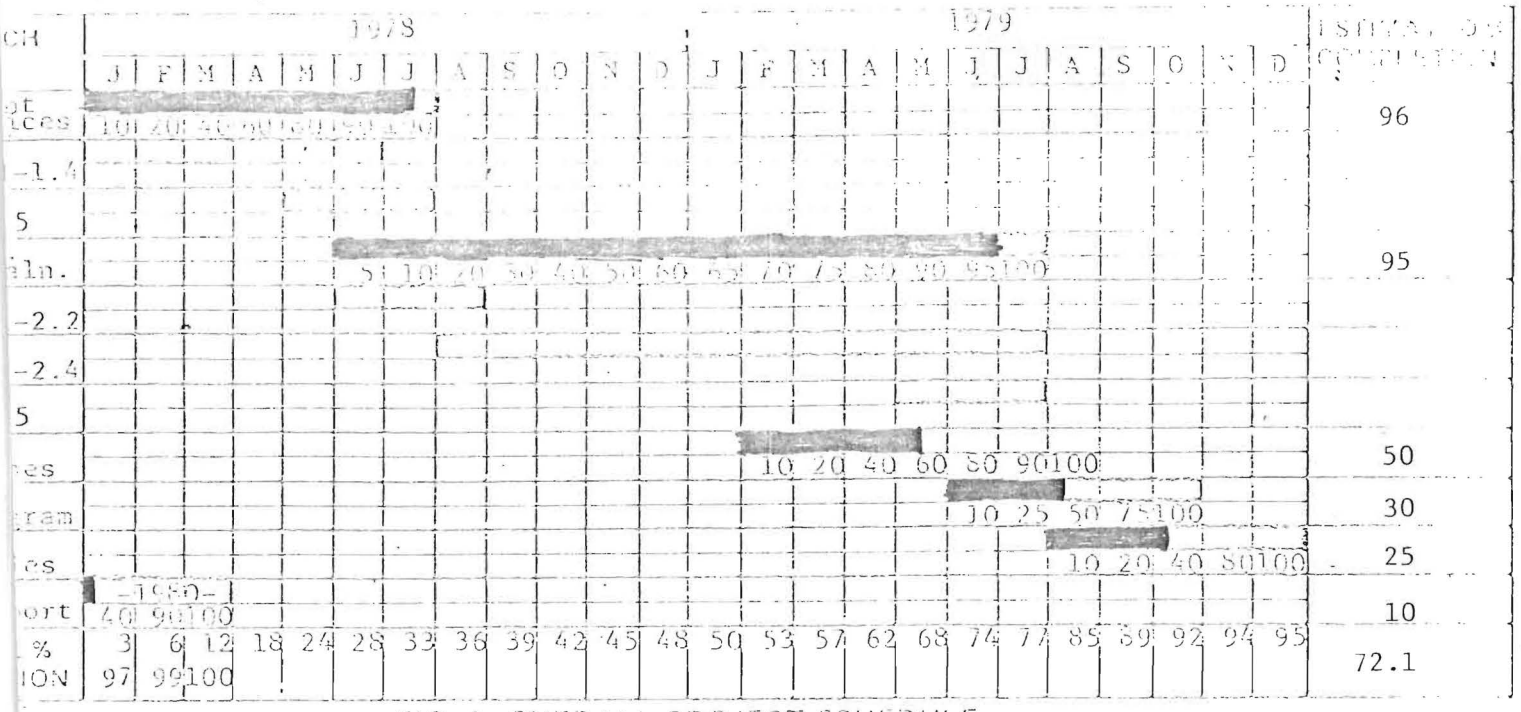


FIG. A--OVERALL PROJECT SCHEDULE

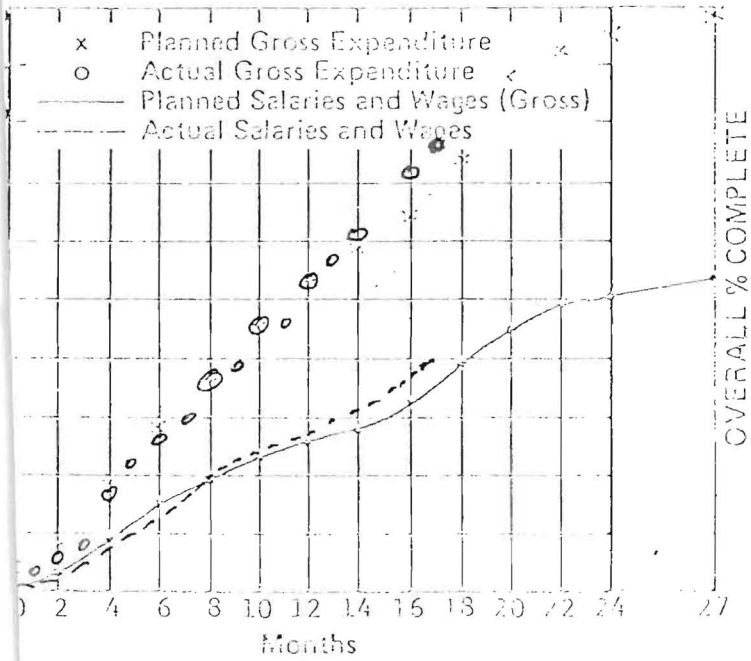


FIG. B--CONTRACT FUNDS

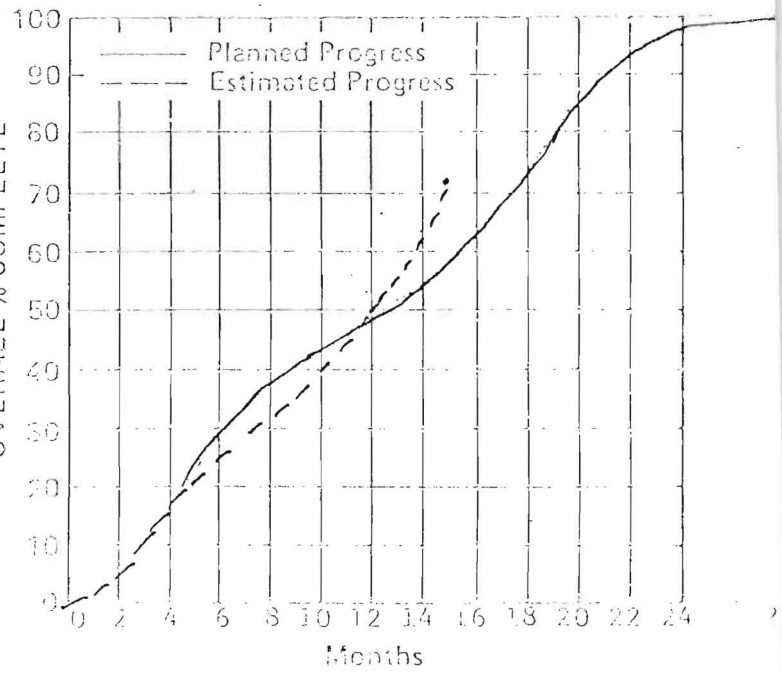


FIG. C--CONTRACT PERIOD

Funds Expended	%	78.0	
Contract Amount	$	149,231.	
Expended this Month	$	3787.	
Total Exp. To Date	$	116,399	
Balance	$	35,824	

Time Elapsed	%	75.1
Starting Date		January 1, 1978
Completion Date		March 31, 1980

Salaries and Wages Planned This Month	$	2888.
Salaries and Wages Spent This Month	$	3487.
Accumulated Salaries and Wages To Date	$	59,904.

A-2092

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

June 28, 1979

Mr. Harry A. Smith, Project Engineer
NCHRP
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

Re: Quarterly Progress Report June 30, 1979
NCHRP Project 4-14 FY '78, Georgia Tech A-2092
"Coating Systems for Painting Old and New Structural Steel"

Dear Harry:

Enclosed is one copy of our sixth Quarterly Report amended from the rough draft I left with you last Tuesday. The rating I assigned S-18 and S-20 systems certain panels of on old steel after one month at Brunswick should read 9 not 7.

45 copies are being sent under separate cover. James Gammage of Florida DOT has promised an answer to our questionnaire and we will phone Wyoming and Puerto Rico again. The new summary of replies now includes 48 replies with little change in the concensus: their major problem is surface preparation and in one form or another they know it.

This month the complete new set of KTA panels were put on marine exposure. I enjoyed our inspection trip to Brunswick and your clarification of details on our final report. We appreciate your efforts to permit us to gather further data before we prepare our proposed guidelines.

Sincerely,

Frank A. Rideout
~~Acting~~ Principal Investigator

FAR:dm
Enclosure(s)
cc:D.J. O'Neil
R.L. Yobs
L.E. Henton
C.J. Ray
P. Hawley
P. Zapfe

QUARTERLY PROGRESS REPORT

to the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

on Project

NCHRP 4-14 FY'79

Coating Systems for Painting Old and New Structural Steel

for period

April 1, 1979 to June 30, 1979

from

Frank A. Rideout, Principal Investigator

Senior Research Scientist
Chemical and Material Sciences Division
Technology and Development Lab
Engineering Experiment Station
Cobb County Research Facility
Atlanta, Georgia 30332

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

NCHRP Project No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL FY 78 Month June 1979

Research Agency Georgia Tech Research Institute (Engineering Experiment Station

Principal Investigator for Frank A. Rideout, Jr. Principal Investigator

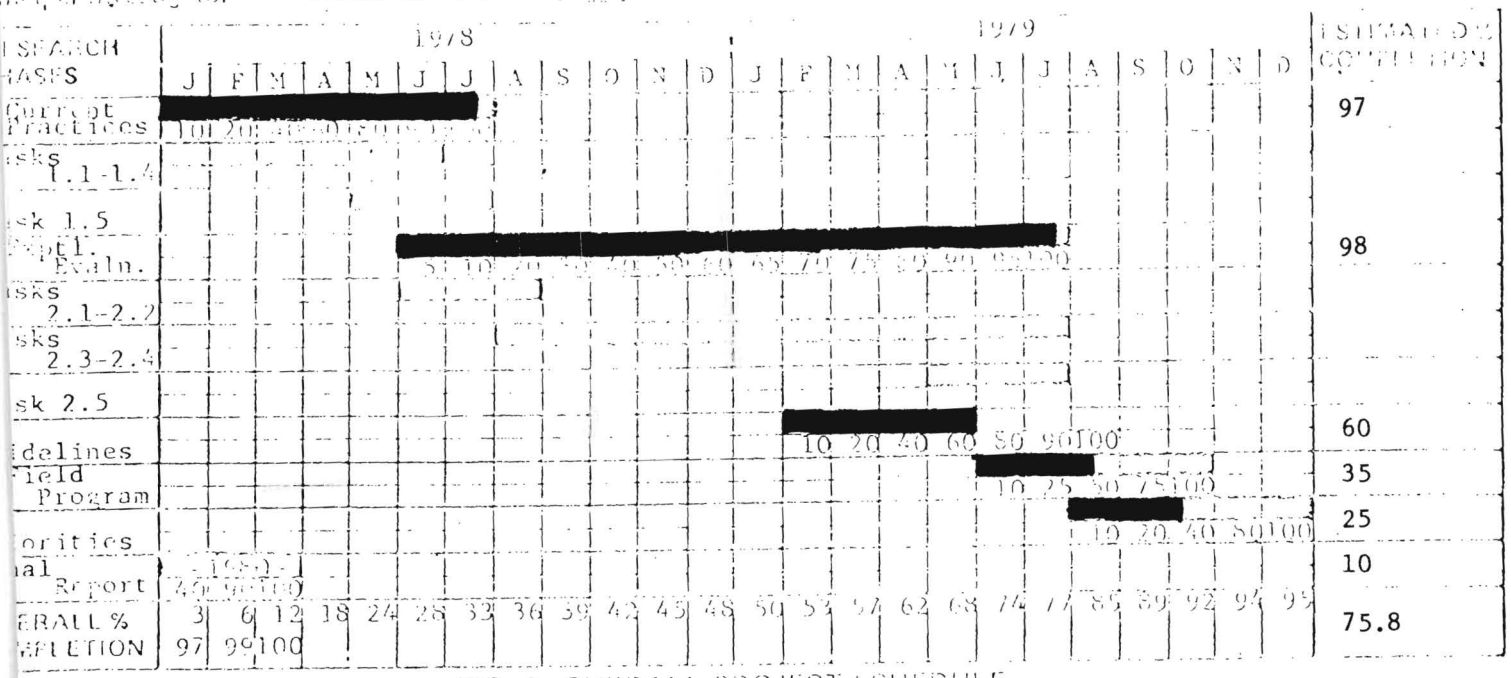


FIG. A- OVERALL PROJECT SCHEDULE

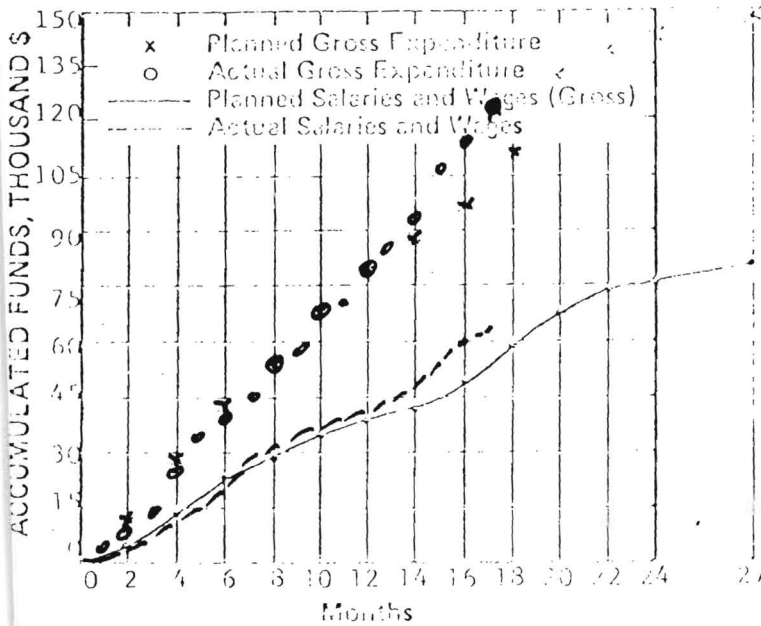


FIG. B - CONTRACT FUNDS

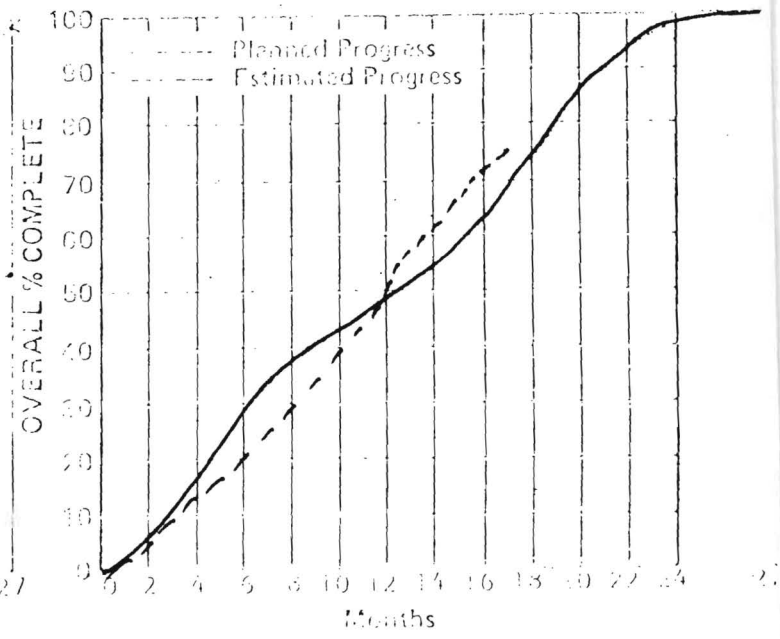


FIG. C CONTRACT PERIOD

Funds Expended	%	81.4
Contract Amount	$	149,231
Expended this Month	$	5,149
Total Exp. To Date	$	121,571
Balance	$	27,660

Time Expended 78.2 %
Starting Date January 1, 1978
Completion Date March 31, 1980

Salaries and Wages Estimated This Month	$	2888.
Salaries and Wages Spent This Month	$	2663.
Accumulated Salaries and Wages To Date	$	62405

Sixth Quarterly Progress Report to NCHRP June 30, 1979

Project 4-14 FY'78

COATING SYSTEMS FOR PAINTING OLD AND NEW STRUCTURAL STEEL

Georgia Tech Project A-2092

I. Objective

The objective is the preparation of guidelines for the use of existing and recently developed non-proprietary coating systems for the painting of structural steel with emphasis on such considerations as:

(a) health and environment

(b) exposure condition

(c) application requirements

(d) economics

II Progress Toward Completion

The experimental work plan of laboratory formulation is virtually completed and results are being compiled.

The schedule of work will be completed and reported on time and be within the budget. We would be on a more solid footing for our recommendations and guidelines if more time and budget were available.

All 20 systems on old steel (in duplicate and at two thicknesses) appear still to be candidates. After 2 months in the salty atmosphere of Brunswick, 10 panels are unchanged and 14 show rust spots at edges and at breaks in the film. The differences at Brunswick should become more apparent by November 1979 (7 months) but a longer time will be needed to weigh the performance of these paints on our test racks on the Georgia Tech campus.

The set of KTA panels of new steel which we exposed at Brunswick starting February 20, 1979 showed premature spot rusting in the pocket along the weld lines and in the crevice due to insufficient paint applied to these problem areas. The effort to get the planned thicknesses (3 to 5 and 6 to 8 mils) resulted in remaking several duplicate sets. To avoid putting on too much paint for our test, the critical corners and intentionally poor welds that make up the KTA panel, were starved. At the end of March we attempted to correct paint starved depressions by cleaning off the rust with phospheric acid, rinsing with alcohol and filling the voids with an artists' brush.

Most systems suffered from this inadequate applications so at the beginning of the second month the series made another start free of visible rust. At the recommendations of SSPC a second set of 6" x 12" flat panels were prepared as a control, a complete repeat of the KTA series. These were put out April 20, and show very little deterioration after two months.

To benefit from this experience and to avoid any doubts about the effect of the patching done on the first KTA series, those panels were made again and another set of 64 KTA panels were put on exposure at Brunswick June 21.

We plan to inspect and rate all the panels with the 3 starting dates each month. The inspection cycle and travel expense is more than we originally planned. The changes we have observed dictates this greater inspection frequency.

Proposed Extension to Present Program

The value of our work to date will be enhanced by adding and extending some of the present tasks. The guidelines will be more useful if some of the tasks listed below could be investigated in greater depth.

1. Repeat salt spray tests of selected systems after a washing (as from a light steady rain) is applied to the series containing latex paint candidates. A week exposure in the weatherometer would give a controlled washing. This is a controversial procedure at one time used by the SSPC latex paint committee. The difference before and after a washing is easily apparent by drying and noting how a drop of water wets a horizonal paint film using various latexes. We have used 14 days air dry in the lab to condition panels before testing but the washing step may be more realistic for average exterior exposure.

A logical next step in our test program would be to expose selected latex systems to environments for film exposure less aggressive than marine atmosphere yet with abundant rainfall.

2. Florida DOT has recently repainted at least 4 carefully selected steel bridges with latex paint systems that proved promising in bridge beam tests. An inspection trip within the next few months in company with the sponsoring chemist from the Florida DOT Materials Lab would be illuminating especially since a variety of Florida environments at different distances from salt water was included. Although not specifically detailed in our Work Plan, we had this series of trials in mind to follow originally. Our travel budget for this project has already been exceeded and we must rely on telephone and correspondence to gather the new data but this important phase of developing alternative paint systems needs the personal interview. The Acting Principal Investigator assisted in the Florida program even before our participation in Project 4-14.

3. Louisiana DOT has a number of problems and case histories that were discussed last fall in Baton Rouge. Another visit would be helpful and bring new insights. Carboline Corp. has been involved and has offered to put their personnel and files at our disposal to pursue a more practical specification for coating coastal bridges. This visit to St. Louis lacks only budget.

4. The weatherometer time specified for our Task 2.4 (1000 hours) is now approaching 1500 hours with little difference showing among the 16 systems (and duplicates). We would propose to continue this test until greater differences are evident. Only the epoxy shows a substantial loss of gloss.

5. The panels on exposure on the Georgia Tech campus appear to change more slowly than we expected. Additional months will be especially revealing for the coatings over old painted steel.

6. The latest panels exposed at Brunswick will require until June 21, 1980 to show a years' weathering. We especially chose 3 to 5 and 6 to 8 mils for our test instead of an expected recommendations for practical bridge coating of 10 mils in order to accelerate rust formation. Even these thicknesses, necessary to assure complete coverage and good film formation, appear to be more durable than the months remaining in our contract.

7. New bridge trials of urethanes on rusty steel in Pittsburgh and on clean steel on the North Carolina seacoast are good examples to witness or inspect personally.

8. Our DOT contact at Delaware points to a new vinyl trial near the coast, which has invited our witness.

III. Progress by Phase

Phase I. Current Practices

A summary of the 4 additional states, who have replied to our questionnaire follows with a tabulation of the replies. By June 30, 1979 we will try to make telephone contact with the remaining departments: Florida, Wyoming, Puerto Rico, and the District of Columbia.

Phase 2. Experimental Evaluation of Recently Developed Systems

The inspection and evaluation of the KTA panels at the marine site at Brunswick, Ga., after four months exposure, showed all systems are remaining stable except for small application imperfections. April 21st we placed on the racks at Brunswick an additional set of flat .064" steel (6" x 12") with the first 16 systems shown in our Table 1 to serve as a check on the KTA panels. We also placed a duplicate set of the KTA panels on exposure at Brunswick, Ga. on June 21, 1979. Each system was applied at 2 thicknesses and in duplicate.

All the recoated old steel panels appeared to be in good condition except panel 183 (S18) and panel 203 (S20). Both of these panels which used latex paint, have rust blooming giving a rating of "9" at the end of one month at Brunswick. Some of the old steel panels showed rusting, where the numbers were punched. This was noted and recorded.

For the laboratory accelerated weathering tests, all systems were applied to steel panels, using previously outlined methods and weatherometer testing begun on April 20, 1979. Gloss and tristimulus (color) readings were taken before testing and are being taken every 500 hours and recorded. All systems appear to be in good condition, after the 500, and 1000 hour periods. The 1500 hour period will not be complete until July 2, 1979.

The salt-fog spray testing was begun on May 28, 1979. Rust spots appeared in 24 hours on panels made from systems S2, S12 and S13 and by 216 hours the following systems were judged more than 10% rusted and removed from further salt spray testing: S6, 7, 11, 12, 13 and 14. All these included a latex paint yet 3 other latex systems (S2, 4 and 15) showed less than 10% rust until 504, 504 and 600 hours respectively.

REVIEW OF STATE DOT REPLIES TO NOVEMBER, 1978 NCHRP 4-14 QUESTIONNAIRE

STATE	1. CHANGES?	2. WHY?	3. ZONES?	4. REG. EFFECT CTG.?	5. MOST CRITICAL	6. RESEARCH NEEDS?
48 Replies	Yes: 41 (85%) SB: 23 (48%) Zinc: 16 (33%) Vinyl:14 (29%) A-588: 8 (17%)	Longer life 25 (52%) Regulations: 12(25%) Fast dry: 6 (13%)	9 (19%)	Yes: 16 (33%) Minimal: 6 (13%)	Surface Prep. 42 (88%) Application: 18 (38%)	Material: 25 (52%) Inspection: 6 (13%) Regulations:14 (29% Surface Prep.: 19 (40%) Water-borne: 4 (8%)
Abbreviations	SB - Sandblasting OZ - Organic Zinc IZ - Inorganic Zinc PU - Polyurethane Pb - Lead Reg - Regulations W-B - Water-borne					
Alabama	No		No	Yes, fast dry near water supply	Surface preparation paint quality	Better paint
Alaska	Solvent remove oil or grease Com'l SB(SSPC-SP6)	Longer life, Uniform bidding, Aesthetics	No	None	Surface preparation Primer application	Application Limitations
Delaware	A-588 Steel unpainted Zinc over SSPC-SP10, Vinyl near coast. Re-paint alkyd: Tie coat and Hi Build Vinyl. Blast to SSPC-SP6 for M-50.	Longer life	General and coastal	Minimal	Metal Preparation	Materials & methods for old and new steel to meet environmental needs.
Hawaii	Zinc, wash primer new alkyds and pigments. Tighter federal specs	To try new systems	No	None	Workmanship in surface Preparation and application	Primer for surfaces not properly prepared
Massachusetts	Yes, M-50, more alkyd Trials: Zinc, Vinyls	Easier application Less weight	Yes, General Industrial & Coastal	Formulating non-Pb and non-CrO_4. Blast cleaning limited.	Surface preparation	Repainting and cleaning
Mississippi	No	None	No	None	Cleaning	Cleaning

A-2092

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

August 3, 1979

Harry A. Smith, Project Engineer NCHRP
Transportation Research Board
2101 Constitution Avenue NW
Washington, D. C. 20418

Re: July 1979 Project Report NCHRP 4-14, FY'78, Georgia Tech No. A-2092
"Coating Systems for Painting Old and New Structural Steel"

Dear Harry:

We enclose 3 copies of our July Monthly Progress Schedule.

The Florida DOT reply to our questionnaire came in with thoughtful answers. For future research: "....economics in painting needs research as to best system choice, guidelines for choosing between touch-up and repainting, effect of future regulations on cost, choosing low cost paints for limited service, etc."

The June 23 inspection of the original KTA set of panels, now exposed 5 months, showed no substantial deterioration except for tiny pinpoint rust spots. None is worse than 2% of the area rusted and other properties of blistering, cracking, peeling and chalking have not appeared on any of this series. The replacement set of KTA panel put out June 21 showed no change.

The set of 12" x 12" panels cut from an old Atlanta bridge control cleaned and topcoated with the alkyd control and the five "new" topcoats indicate after 4 months at Brunswick that urethane, epoxy and alkyds make better refinish coats than latex or vinyls. Only the 9" square in the center of the 12" x 12" panel is used for this evaluation because of the rough edges and oil contamination during cutting. It is still too soon to draw conclusions.

The set of old painted steel on the Georgia Tech Campus test fencw shows no sign of deterioration after 4 months exposure (45°S) except one panel of S32 that shows tiny rust spots noted at the third month.

Weatherometer testing shows the loss of gloss now at 2000 hours, which is sometimes compared to around 5 years of real sunlight. Attached is a table of our raw data. The breakdown since 1500 hours for the control, the urethane and the vinyl formulations is more than we would expect.

Salt spray tests show systems S1, S3, S5, S8, S9 and S16 still rated 7 or better at 1572 hours.

Sincerely,

Frank A. Rideout
Principal Investigator
CMSL

FAR:gp

Enclosures (3)

NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

Project No. 4-14: [illegible] FOR STRUCTURAL STEEL — FY 78 — Month July, 1979

Agency Georgia Tech Research Institute (Engineering Experiment Station)

Investigator Frank A. Ridout, Principal Investigator

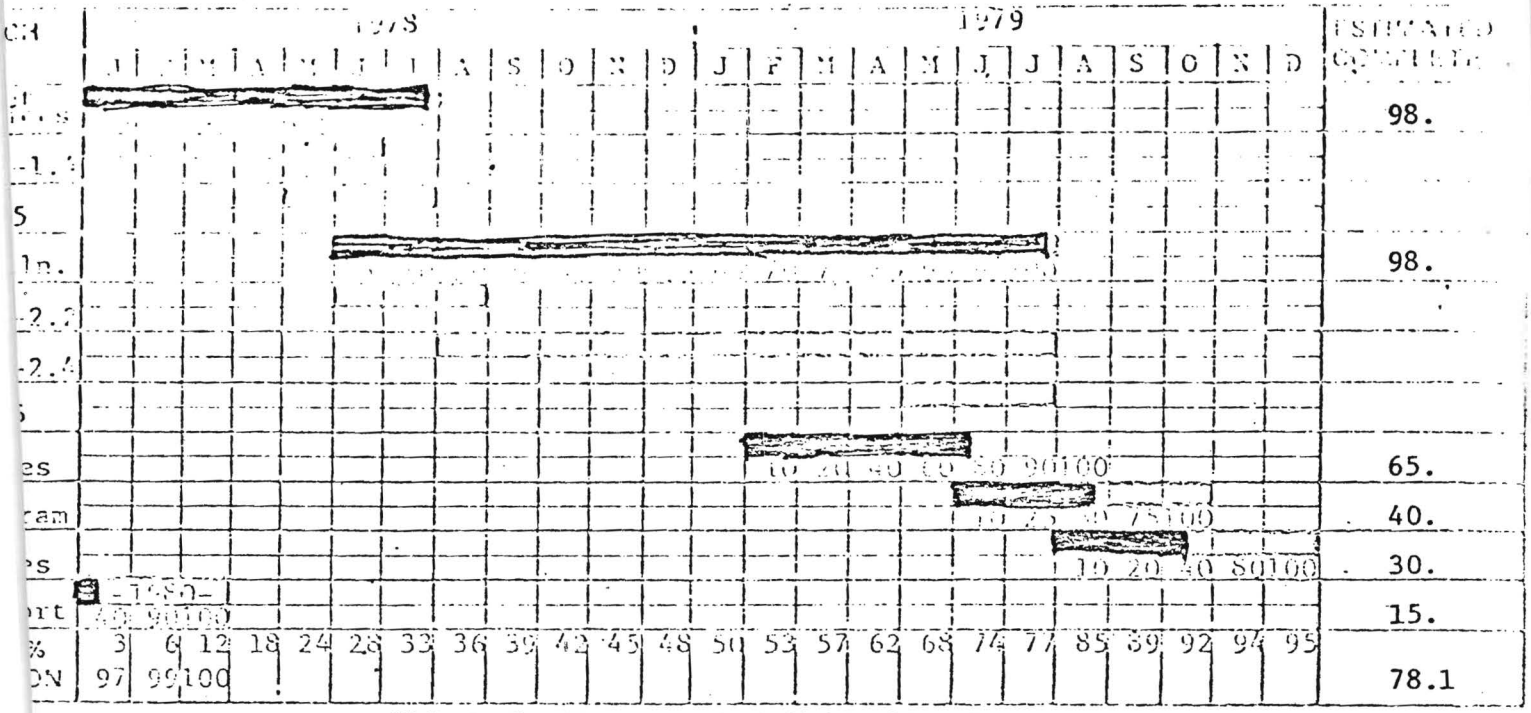


FIG. A–OVERALL PROJECT SCHEDULE

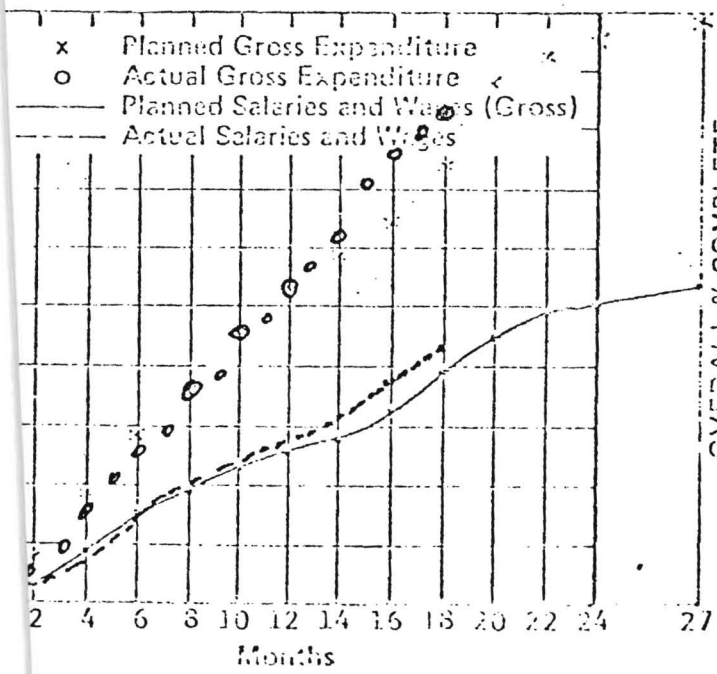


FIG. B- CONTRACT FUNDS

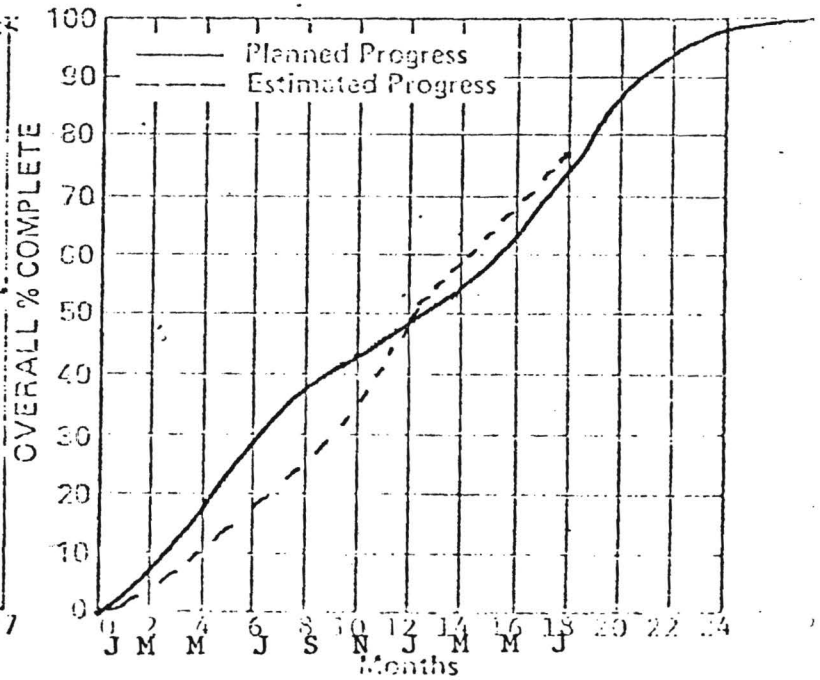


FIG. C -CONTRACT PERIOD

Funds Expended	% 84.2
Contract Amount	$ [illegible]
Expended this Month	$ 4048.
Total Exp. To Date	$125,649.
Balance	$ 23,582.

Time Expended %	80.7
Starting Date	January [illegible], 1978
Completion Date	March 31, 1980

Salaries and Wages Expended This Month	$ 2888.
Salaries and Wages Planned This Month	$ 2098.
Accumulated Salaries and Wages To Date	$ 64,402.

20.0008

GLOSS RATING VS. TIME IN WEATHEROMETER

0	500	1000	1500	2000	no. hrs.
A / B	A / B	A / B	A / B	A / B	
34.6/ 31.3	29.8/ 23.6	25.3/ 20.7	23.7/ 19.4	13.4/ 8.6	
26.8/ 34.4	24.9/ 28.1	21.5/ 23.5	19.9/ 21.1	13.6/ 11.8	
81.3/ 83.9	43.5/ 45.4	25.3/ 33.9	19.5/ 27.5	11.4/ 23.4	
17.2/ 21.7	15.3/ 20.5	13.9/ 19.8	13.9/ 18.6	7.4 / 8.2	
15.8/ 11.3	15.6/ 12.6	15.4/ 12.3	14.8/ 11.9	6.1 / 6.1	
41.5/ 45.1	33.6/ 30.2	29.4/ 24.6	26.7/ 24.1	24.3/ 13.6	
18.8/ 21.5	18.7/ 19.9	17.4/ 20.0	17.2/ 17.9	11.6/ 7.5	
29.2/ 15.4	18.6/ 11.3	17.0/ 10.2	10.5/ 10.0	-1.6/ 4.9	
55.6/ 50.9	45.4/ 35.5	37.6/ 29.6	33.8/ 26.9	24.9/ 10.9	
19.2/ 19.3	9.0 / 13.1	8.3 / 9.7	5.4 / 7.5	0.9 / 2.0	
29.1/ 29.9	25.3/ 23.9	23.4/ 20.6	22.1/ 18.8	16.8/ 11.2	
38.0/ 37.8	34.1/ 29.4	30.0/ 24.9	27.7/ 21.5	25.5/ 13.9	
40.9/ 45.8	37.5/ 37.4	32.0/ 32.1	30.1/ 28.6	26.5/ 17.7	
14.6/ 15.6	13.2/ 13.9	11.2/ 11.0	10.7/ 11.4	3.5 / 6.8	
3.5 / 3.6	3.9 / 3.8	4.0 / 4.0	3.8 / 3.7	-5.0/ -1.1	
51.3/ 46.5	40.4/ 38.6	33.8/ 32.1	31.5/ 32.1	20.3/ 21.7	

A-2092

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

August 31, 1979

Harry A. Smith, Project Engineer NCHRP
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D. C. 20418

Re: August 1979 Project Report NCHRP 4-14, FY '78, Georgia Tech Project No. A-2092, "Coating Systems for Painting Old and New Structural Steel"

Dear Harry:

Enclosed are 3 copies from August Monthly Progress Schedule.

The August 17 panel inspection at Brunswick showed no substantial change. One of the original KTA panels of System S6 had fallen to the ground due to a bolt rusting through and two chips came off the topcoat based on Latex 820. We restored the panel but will have to rely more heavily on the results of the other 3 panels of this system. All these three are rated 9 or 10, nearly perfect at this 6 months exposure.

Please note the error in my last month's report. The third paragraph begins "The June 23 inspection" and it should be July 23 for the fifth month of the first KTA test series. Please correct your copies.

We are now using a grid to measure the area of the panels rusted in the salt spray cabinet that gives a more precise rating. The alkyd control, S10, was more than 25% rusted at 2000 hours and removed but systems S1, S2, S3, S4, S5, S8, S9 and S16 remain on test at 2341 hours.

Sincerely,

Frank A. Rideout
Principal Investigator
Chemical & Material Sciences Laboratory

FAR:gp
Enclosure(s)

TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

Project No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL FY 78 Month August 1979
h Agency Georgia Tech Research Institute (Engineering Experiment Station
l Investigator Frank A. Rideout, Acting Principal Investigator

RCH S	1978 J	F	M	A	M	J	J	A	S	O	N	D	1979 J	F	M	A	M	J	J	A	S	O	N	D	ESTIMATED COMPLETION
ept tices	10 20 40 60 80 100																								98%
1-1.4																									
.5																									
l. valn.						5 10 20 30 40 50 60 65 70 75 80 90 95 100																				100%
1-2.2																									
3-2.4																									
.5																									
nes													10 20 40 60 80 90 100												75%
gram																		10 25 50 75 100							60%
ies																				10 20 40 80 100					50%
port	1980 40 90 100																								20%
L % TION	3 97	6 99	12 100	18	24	28	33	36	39	42	45	48	50	53	57	62	68	74	77	85	89	92	94	95	83.9%

FIG. A—OVERALL PROJECT SCHEDULE

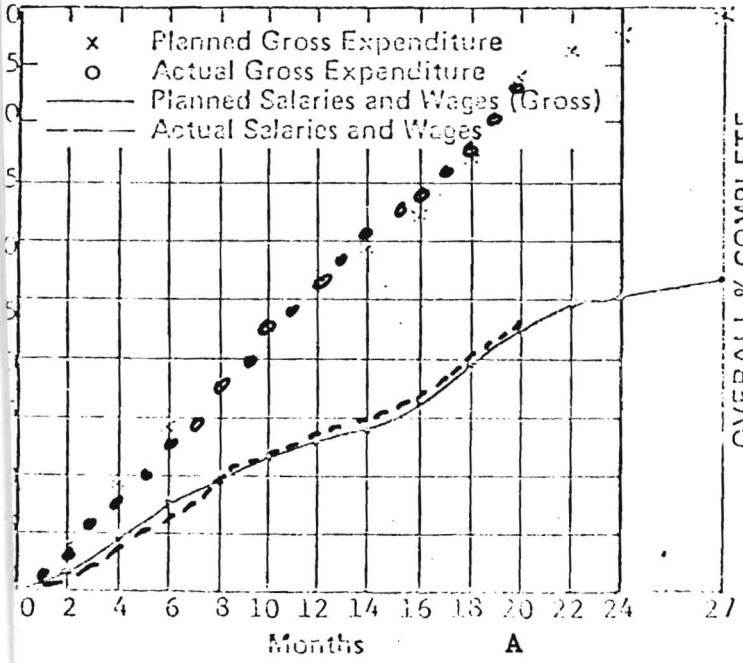


FIG. B—CONTRACT FUNDS

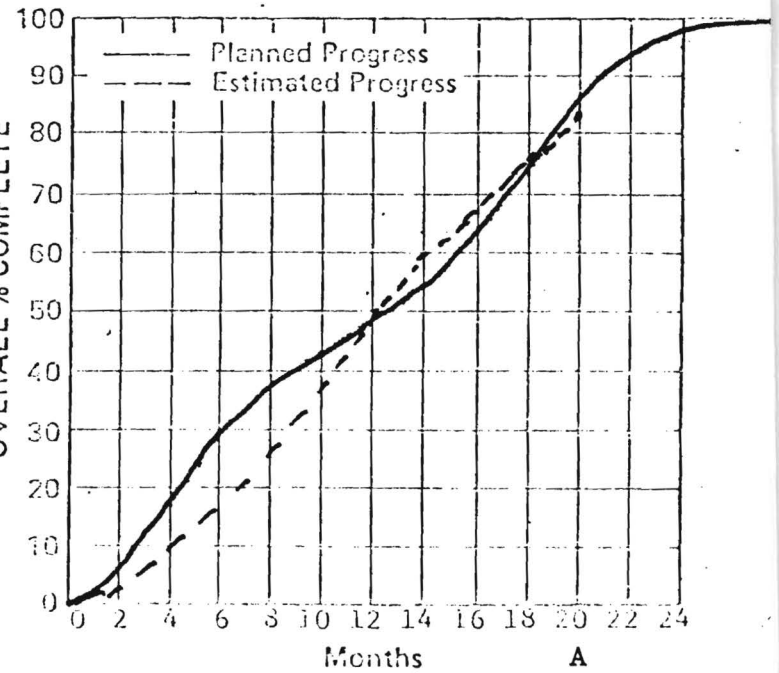


FIG. C—CONTRACT PERIOD

Funds Expended	%	88.2	
Contract Amount	$	149,231	
Expended this Month	$	5,197	
Total Exp. To Date	$	131,652	
Balance	$	17,579	

Time Expended %		84.1
Starting Date		January 1, 1978
Completion Date		March 31, 1980

Salaries and Wages Estimated This Month	$	2,880
Salaries and Wages Spent This Month	$	2,630
Accumulated Salaries and Wages To Date	$	67,107

/75

20.0008

A-2092

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

September 20, 1979

Harry A. Smith, Project Engineer NCHRP
Transportation Research Board
2101 Constitution Avenue, N.W.
Washington, D. C. 20418

Re: September Quarterly Progress Report NCHRP 4-14, FY '78, Georgia Tech Project No. A-2092, "Coating Systems for Painting Old and New Structural Steel".

Dear Harry:

Attached is 1 copy of our September Quarterly Report.

We are asking our Reports and Procedures people to make necessary duplications to send you 45 copies to reach you by September 28th.

Sincerely,

Frank A. Rideout
Principal Investigator
Chemical Material & Sciences Laboratory

FAR:gp

Enclosure

QUARTERLY PROGRESS REPORT

to the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

on Project

NCHRP 4-14 FY'78

Coating Systems for Painting Old and New Structural Steel

for period

July 1, 1979 to Sept.30, 1979

from

Frank A. Rideout, Principal Investigator

Senior Research Scientist
Chemical and Material Sciences Laboratory
Engineering Experiment Station
Cobb County Research Facility
Atlanta, Georgia 30332

PROGRESS SCHEDULE

Sept., 1979

Principal Investigator

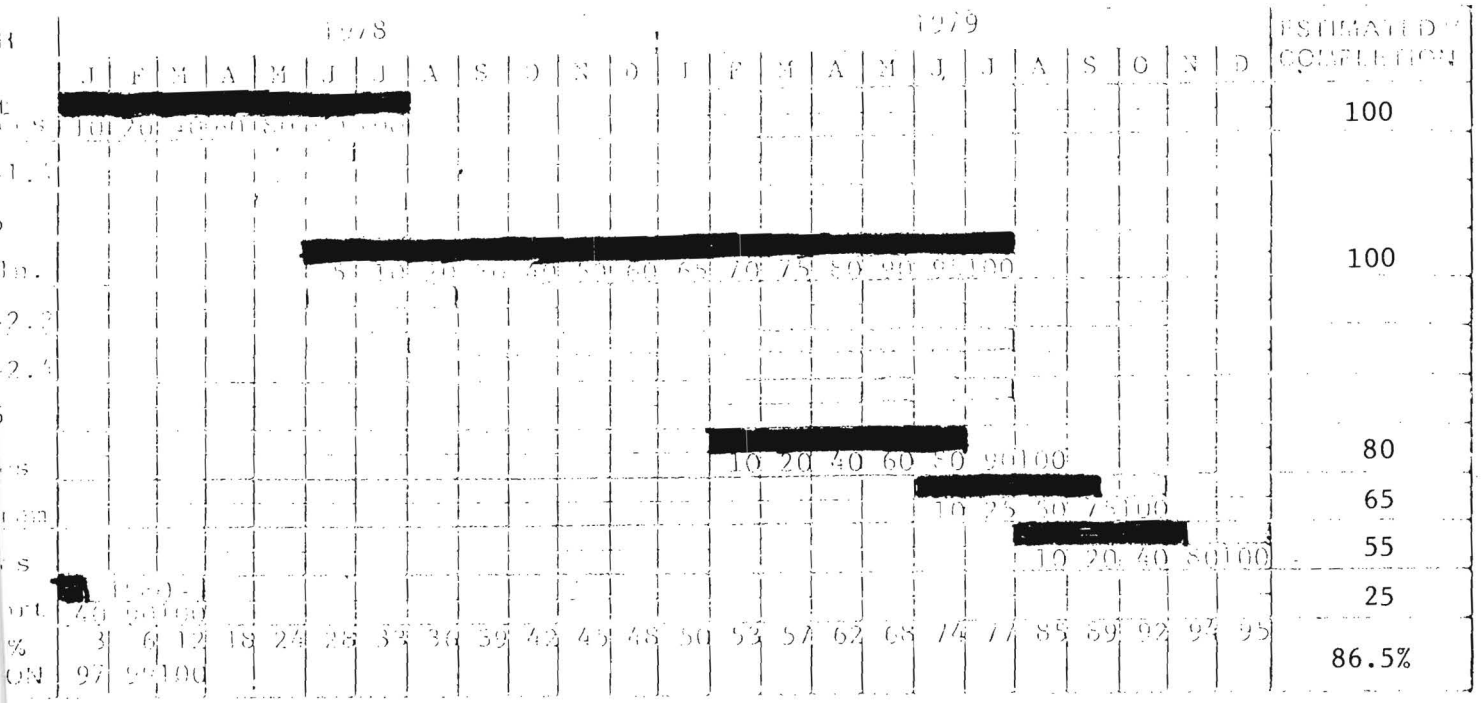


FIG. A - OVERALL PROJECT SCHEDULE

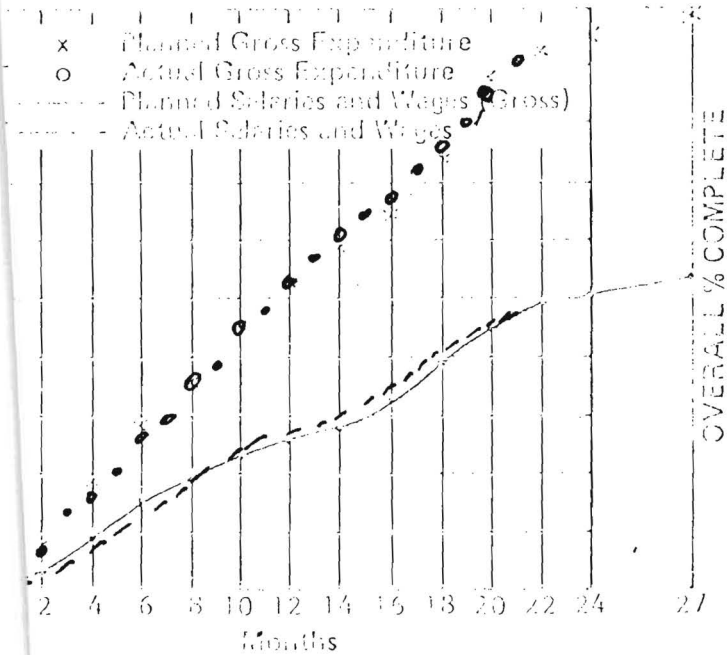


FIG. B - CONTRACT FUNDS

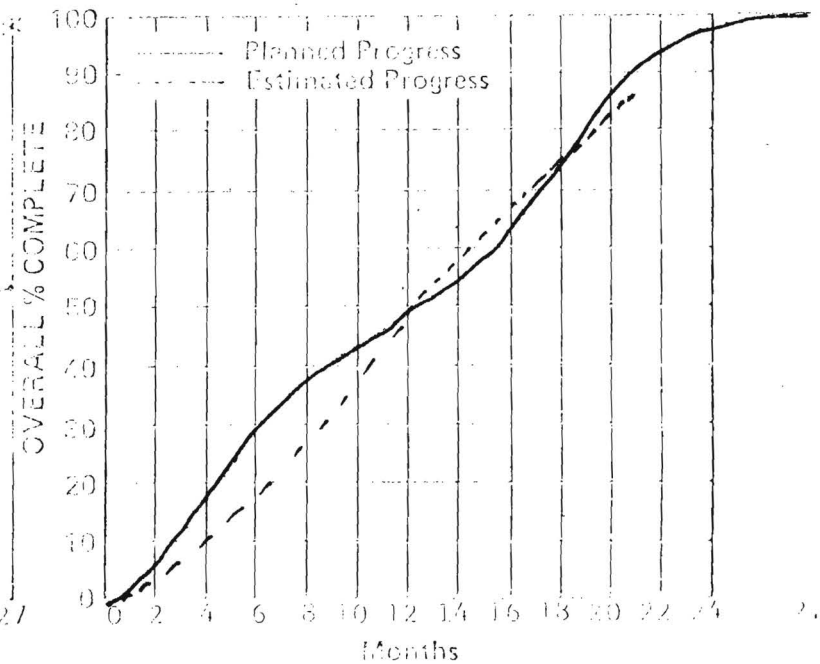


FIG. C CONTRACT PERIOD

Funds Expended	%	91.1
Contract Amount	$	[illegible]
Expended [illegible]	$	4,300.
[illegible]	$	135,905.
[illegible]	$	14,126

Time Expended % 86.9

[illegible] January 1, 1978

[illegible] March 31, 1979

[illegible]	$	2880.
[illegible]	$	2225.
[illegible]	$	69,333.

Seventh Quarterly Progress Report to NCHRP September 30, 1979

Project 4-14 FY'78

COATING SYSTEMS FOR PAINTING OLD AND NEW STRUCTURAL STEEL

Georgia Tech Project A-2092

I. Objective

The objective is the preparation of guidelines for the use of existing and recently developed non-proprietary coating systems for the painting of structural steel with emphasis on such considerations as:

(a) health and environment

(b) exposure conditions

(c) application requirements

(d) economics

II. Progress Toward Completion

The laboratory testing of the coating system selected for evaluation will be complete by September 30. Results will be correlated in a common listing with test fence results both from Brunswick ocean exposure and Ga. Tech campus. Results of recoating old steel will tell about the new systems exposed at Brunswick and about new pigments in standard alkyd exposed in Atlanta.

By mid December 1979 the test fence panels will have been exposed as shown:

Initial Exposure	Panels	Exposure Site	Months by December
February 20, 1979	88 new KTA	Brunswick	10
March 19, 1979	4 old 12"x12"	Brunswick	9
April 20, 1979	64 new 6"x12"	Brunswick	8
June 21, 1979	64 new KTA	Brunswick	6
March 21, 1979	26 old 12"x12"	Atlanta Campus	9

One half have coating thickness close to 4 mils and the other half about 7 mils thick in order to see the differences earlier than when the full 10 mils normally recommended for marine exposure is used. Little change is evident since our June 30 report.

Through the cooperation of Dick Ramsey of the Florida DOT, on August 20 we were able to see the excellent condition of a three coat latex system on the "I" beams of Route 138 bridge over the Swannee River. The green 9 mil coating is about 35 feet above the water and showed no rust spots or any other fault after 15 months. Florida has at least 3 other bridges including marine exposure coated with all latex or latex over zinc rich primers that we plan to follow.

An interesting guideline suggested by the Carboline Company in our visit to St. Louis, August 14, refers to visible red rust appearance after abrasive blasting. Don't paint if you see any! It is okay to go ahead if you see no red bloom, the surface is dry, you have the profile and clenaliness specified, the temperature is above $50^{o}F$, the wind is below 12 miles per hour, and there is no sign of rain. This recommendation for inorganic selfcuring zinc rich may be good advise elsewhere.

III. Progress by Phase

Phase 1. Current Practices

Replies to our questionnaire are in from all states except Wyoming and Puerto Rico. Contact has been made this month by phone and agreement has been received from each to reply promptly to a new copy we have sent.

Phase II. Experimental Evaluation of Recently Developed Systems

All exterior exposure panels were prepared and put out by June 21 but the data comparing the different systems will be 6 to 10 months duration by mid December, the present termination before preparing our draft final report.

All of the laboratory tests will be complete by September 30.

Phase III. Tentative Guidelines for Selection and Application of Coating Systems

Our survey shows about 20% of the states use some kind of a zone system to classify exposure conditions and specify surface preparation and coating system. No single state breaks down their uses into as many classifications as published by NCHRP Project 4-14 in 1968.

Zones Used by States for Painting Specifications in 1978-1979

	General	Coastal	Industrial	Special
Delaware	X	X		
Massachusetts	X	X	X	
California	X	X		
Idaho	X			North
Missouri	X		X	
N. Carolina	X	X		
Oregon		X	X	Inland Wet & Inland Arid
New Jersey		X		Individual
Maine	X	X		
Florida	X	X	X	Individual

We will propose tentative guidelines to fit present practice and try to define the areas more specifically.

Phase IV. Design of a Field Evaluation Program

The new coating systems which show the most promise in approaching the objectives listed in Section 1, using the minimum amount of the least objectionable solvents using acceptable pigments and practical economics, will be suggested for more pilot bridge coating trials.

Phase V. Research Priorities

Application and surface preparation will be prominent in our report with the need for long lasting systems evident.

A-2092

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

October 24, 1979

Harry A. Smith, Project Engineer NCHRP
Transportation Research Board
2101 Constitution Avenue
Washington, D. C. 20418

Re: October Monthly Progress Report NCHRP 4-14, FY'78
"Coating Systems for Painting Old and New Structural Steel"
Georgia Tech Project A-2092

Dear Harry:

We are planning the presentation of our exposure data for our final report when the differences among the candidate coating systems are still small. For the final we expect to show 8 months exposure at Brunswick of the 6 coating systems for repainting old intact paint. Attached is our suggested presentation of the facts at 6 months for your comments.

We will comment on the edge rusting where the primer was damaged by the cutting torch. By hindsight, I wish we had ground the edges smooth and primed them with alkyd but that really is outside the agreed Statement of Work. All other observations of the exposed panels are favorable or unchanged since exposure on March 19, 1979, except chipping. Some small pieces of the paint curling back (old with new on top) with all systems as far except Latex 820 and Epoxy. The worst is latex MV-23: one panel is rated 7 on the 10 to 0 scale.

We are skipping October for a visit to the Brunswick test fence because of our overrun travel budget and feel justified because the change each month is now quite little.

We also enclose a revised example of a formula, T-1, for your approval. In our Quarterly Report for December 1978, we attached a detailed formula sheet, P-6, in the same form as we used to make the paint and in the March 1979, QPR we included a Cost Calculation for this paint, but no reaction has reached us from the panel. Right now with prices escalating so fast and relative costs are so much alike and small as compared to total service life costs that we propose to omit the individual Cost Calculations. All candidate paints are comparably priced when measured on a mil-square foot basis.

The third attachment is one of 4 charts we have prepared to plot the color change. All 16 systems show less color change than the alkyd control.

Thank you for your work of proposing the funds for a follow-on supplementary project and the support it has so far. Are you now in a position to give us something like a "letter of intent" I can use to take to our financial people? It probably will not change anything that will get into our December 31, 1979 preliminary Final Report but we could get started on the additional latex panels we want to test and thereby get a more meaningful exposure duration.

Sincerely,

Frank A. Rideout
Principal Investigator

FAR:gp

REFINISHED OLD BRIDGE PANELS WITH PAINT INTACT EXPOSED AT BRUNSWICK SEACOAST

Listed in order of increasing observed corrosion.
Scale 10 - 0, 9 is 1% rusted or less.

6 MONTHS EXPOSURE

		One Coat (3 to 4 mils)		Two Coats (6 to 7 mils)	
S19	Improved Epoxy/TiO_2 (Shell DRH 151.3)	3.8 mils	9	6.9 mils	9
		3.2	10	6.8	10
S22C	Control Alkyd/Lead	4.1	9	7.5	9
		3.8	10	7.6	10
S18	Acrylic latex X820/TiO_2	3.4	10	6.7	10
		4.1	7	6.5	8.5
S17	Urethane/TiO_2	2.7	9	7.6	10
		3.5	8	6.9	10
S21	HiBuild Vinyl/TiO_2	4.6	8.5	7.6	8.5
		4.8	8.5	6.8	9.0
S20	Acrylic Latex MV-23/TiO_2	3.3	8	6.8	8.5
		3.5	7.5	6.5	8

TWO COMPONENT URETHANE/TiO_2 TINTED BLUE TOPCOAT

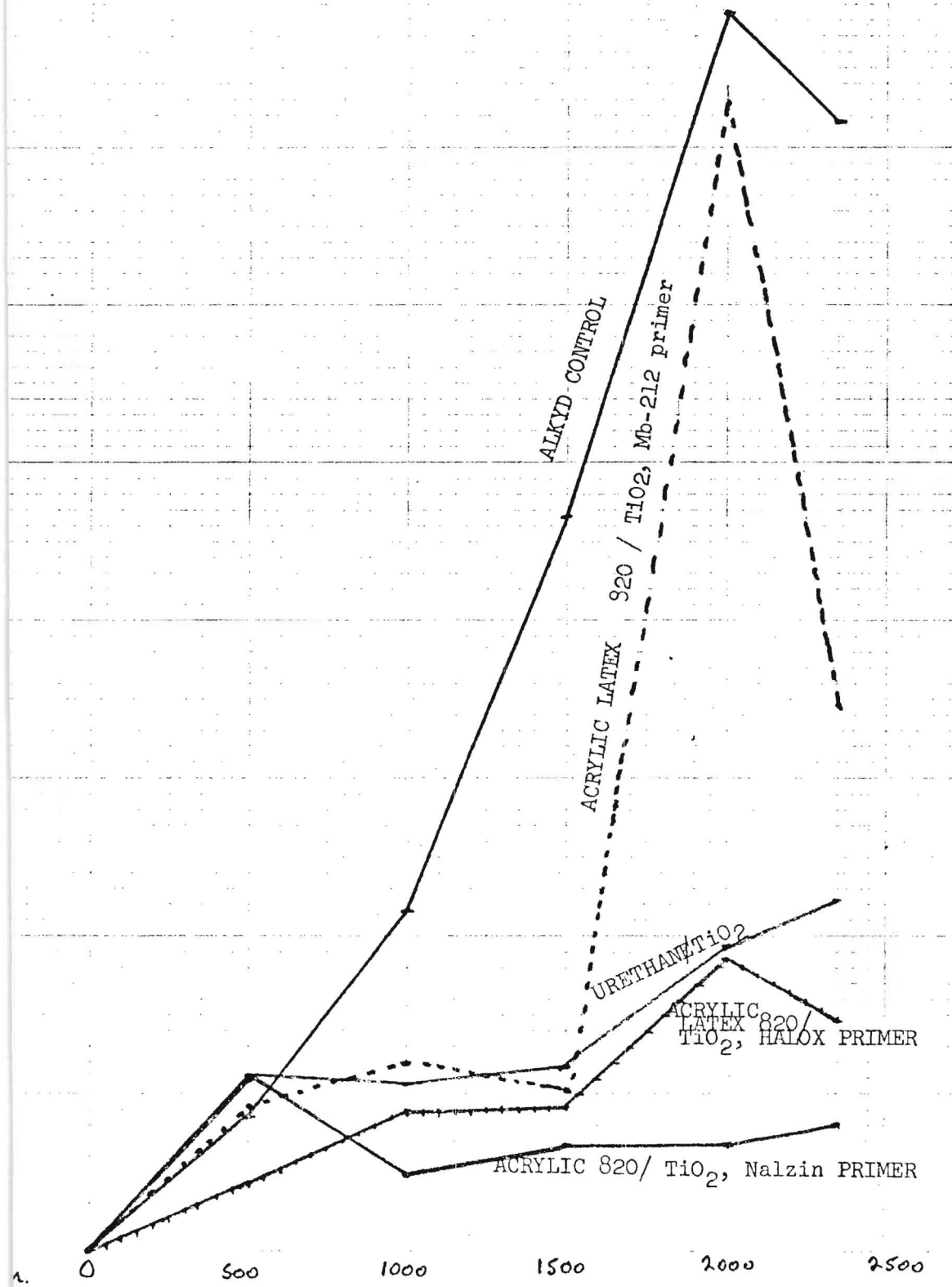
Reference: Mobay NB#255142A

omponent I	Supplier	Pounds		Gallons
itanium Dioxide	DuPont, R 960	247.57		7.260
nthalo Blue	DuPont, BP 366	0.51		.038
arbon Black	Cities Service, Raven 450	0.51		.034
olyester	Mobay, Desmophen 650 A 65	313.05		32.120
olyester	Mobay, Multron R 221 75	29.87		3.260
ntifoam	Byk Mallinckrodt, Byk P 104	6.19		0.790
eveling Aid	Byk Mallinckrodt, Lactimon	6.17		0.810
nixotrope	NL Industries, Bentone 34	5.15		--
urfactant	Byk Mallinckrodt, Anti Terra U	2.58	51.53	6.500*
ylol		43.80	1.53*	6.500*
inc Octoate, 10% in Cell solve acetate		2.09		0.250
ellosolve Acetate		137.48		16.950
otal Component I		795.02		68.000
omponent II				
liphatic biuret isocyanate resin	Mobay, Desmodur N75	285.22		32.000
		1080.22		100.000

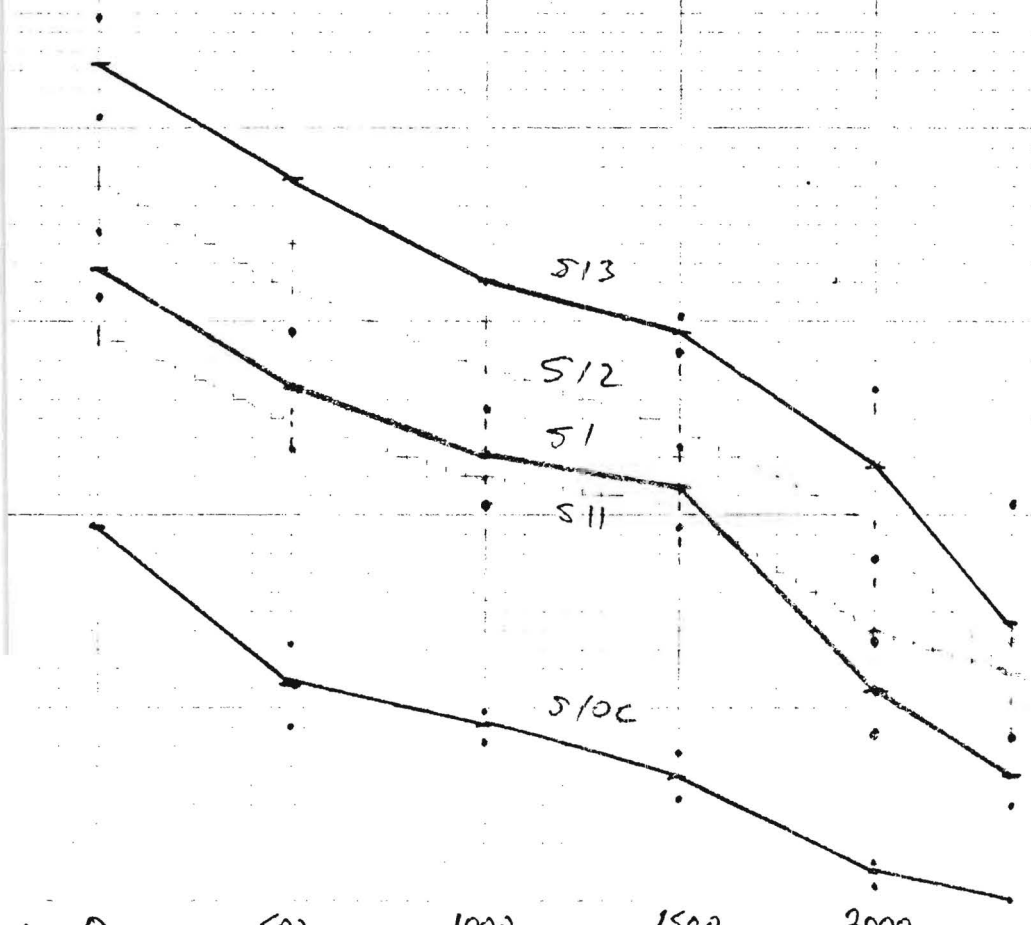
3 Components predispersed

ight/gallon	10.8 lbs.
scosity 77°F #3 Zahn	37 sec.
lids by Weight	65%
lids by Volume	52.5%
gment Volume Concentration	14%
tlife	8 hours
oss 60°	80+

S13 — Total Color Difference E



S13 – 60 Hour Rating vs time in Weatherometer



NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

Project No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL Fy 78 Month Oct. 1979
h Agency Georgia Tech Research Institute (Engineering Experiment Station
l Investigator Frank A. Rideout (Telephone: 404-424-9651)

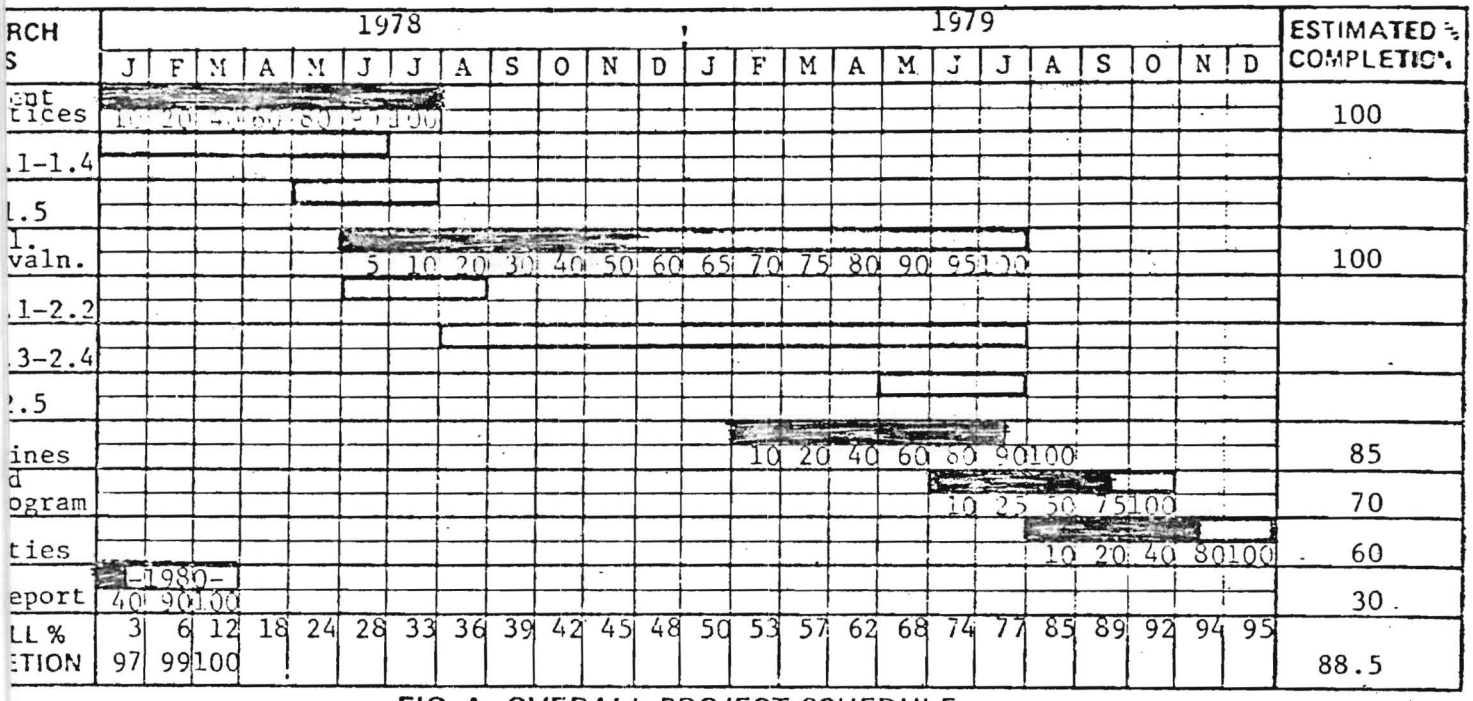


FIG. A—OVERALL PROJECT SCHEDULE

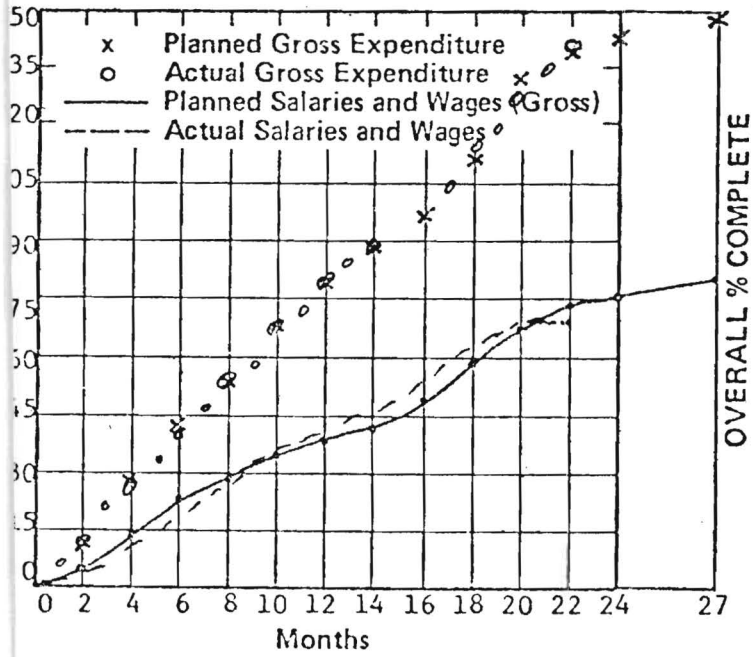


FIG. B—CONTRACT FUNDS

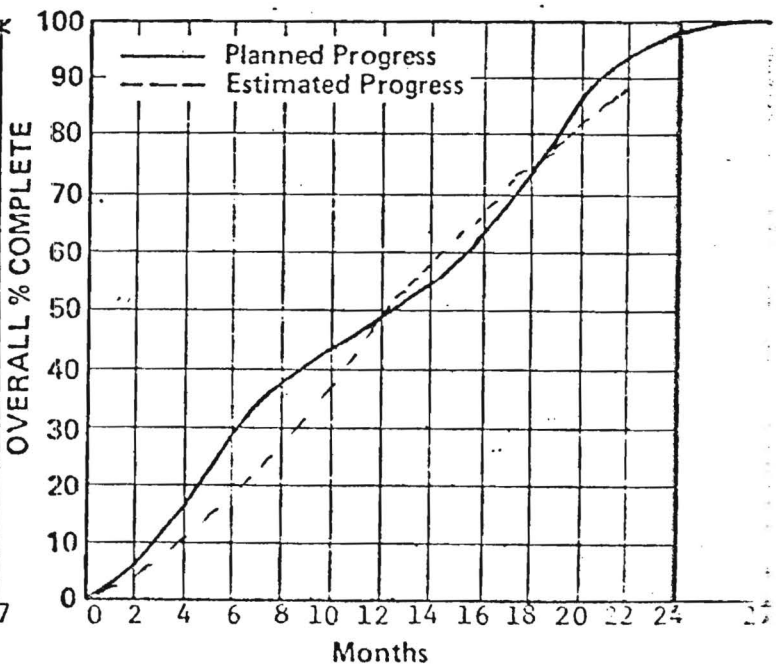


FIG. C—CONTRACT PERIOD

Funds Expended	% 92.2
Contract Amount	$ 149,231
Expended this Month	$ 2,955
Total Exp. To Date	$ 137,591
Balance	$ 11,640

Time Expended %	88.0
Starting Date	January 1, 1978
Completion Date	March 31, 1980

Salaries and Wages Estimated This Month	$ 2880.
Salaries and Wages Spent This Month	$ 1466.
Accumulated Salaries and Wages To Date	$ 70,193

H-2092

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

November 28, 1979

Harry A. Smith, Project Engineer NCHRP
Transportation Research Board
2101 Constitution Avenue
Washington, D. C. 20418

Re: November 1979 Monthly Progress Report, NCHRP 4-14, FY'78
"Coating Systems for Painting Old and New Structural Steel"
Georgia Tech Project A-2092

Dear Harry:

Your letter of November 13 arrived November 20 because the envelope showed our zip code as 03332. As you know, I was making the final panel inspection at Brunswick November 19 and 20. If I had known of your visit I would have made the inspection one day earlier and been back to see you.

This inspection was the first 2-month interval and the ratings declined as would be expected from the previous observations, except for chalking which seems to have started in earnest. It is interesting to note that the gloss ratings in the weatherometer also took a jump between 1500 and 2000 hours.

Thank you for your further words on the possible continuation. If the funds are approved early next year, even though not available until October 1, 1980, we will request permission of Georgia Tech's financial management to maintain our work with a minimum of interruption. In any event, I will do what I can personally, to maintain a record of weathering data on our panels.

Sincerely,

Frank A. Rideout
Principal Investigator

FAR:gp

TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

Project No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL FY 78 Month Nov. 1979
Agency Georgia Tech Research Institute (Engineering Experiment Station)
Investigator Frank A. Rideout, Principal Investigator

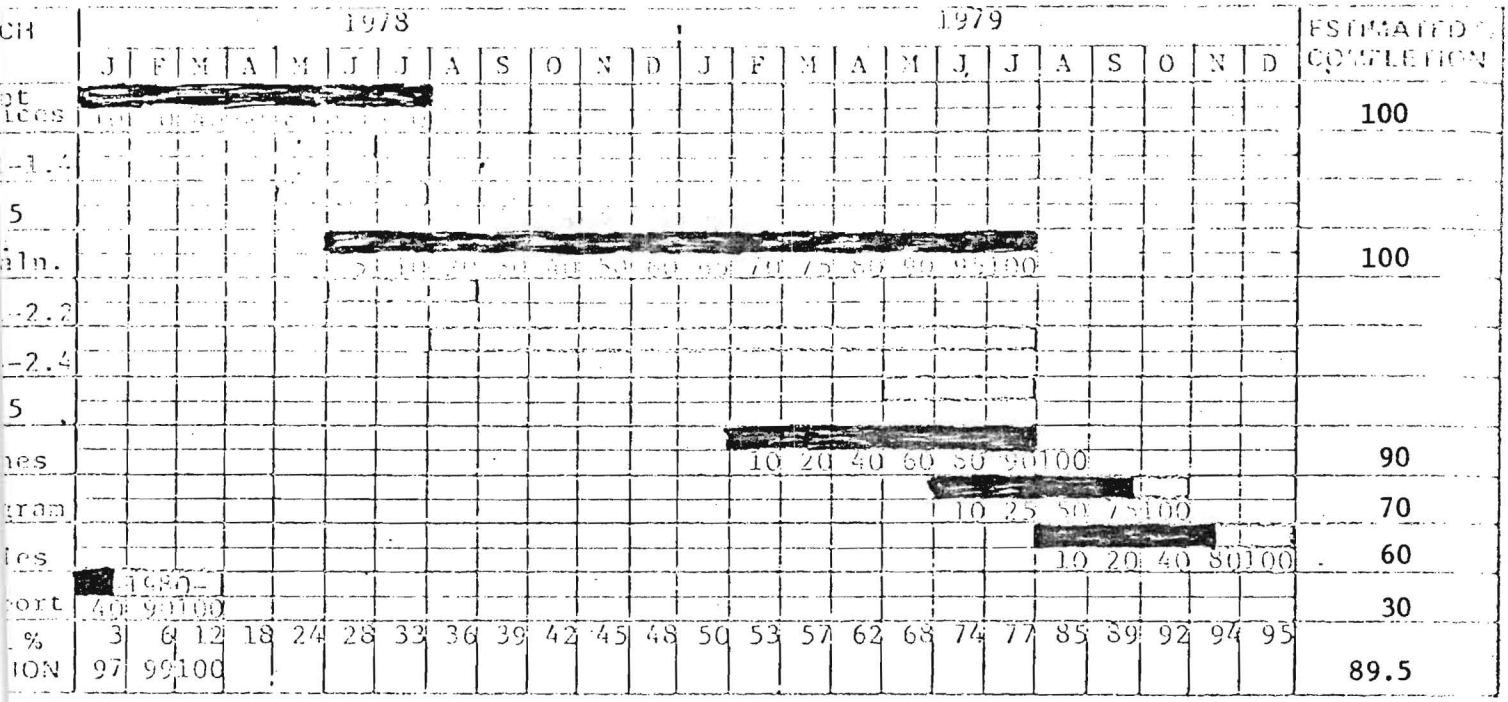


FIG. A—OVERALL PROJECT SCHEDULE

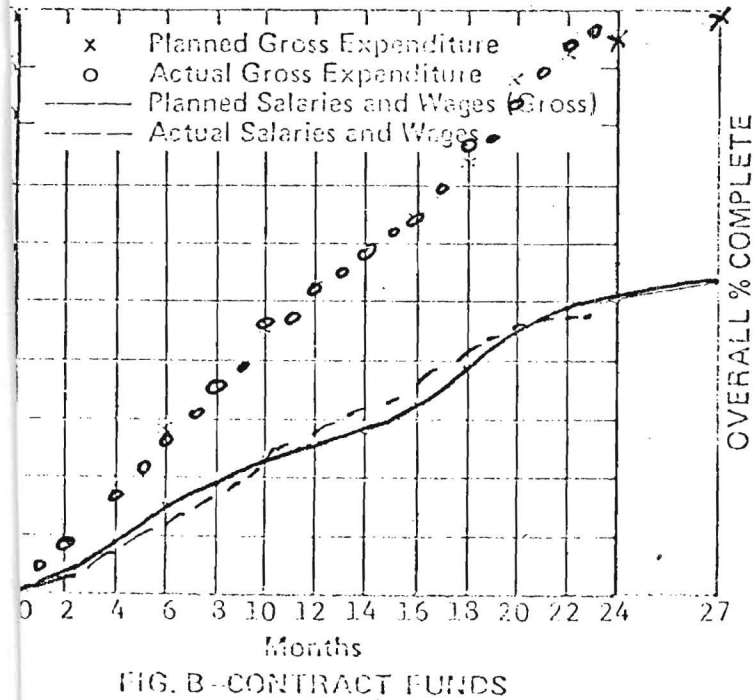


FIG. B—CONTRACT FUNDS

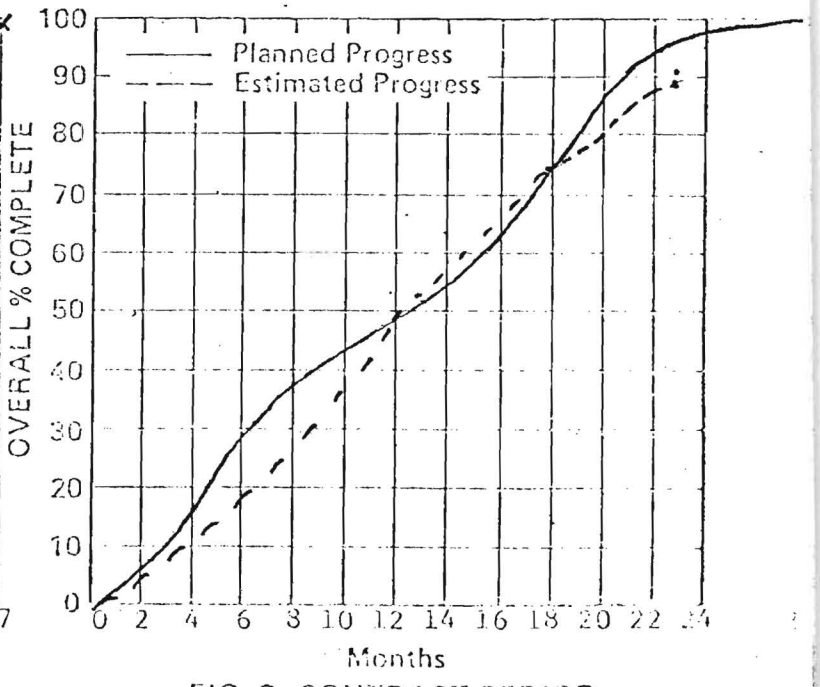


FIG. C—CONTRACT PERIOD

Funds Expended	%	95.8	
Contract Amount	$	149,231	
Expended this Month	$	4863.	
Total Exp. to Date	$	142,970.	
Balance	$	6,261.	

Time Expended %		91.4
Starting Date		January 1, 1978
Completion Date		March 31, 1980

Salaries and Wages Expended this Month	$	2880.
Salaries and Wages Spent this Month	$	2515.
Accumulated Salaries and Wages to Date	$	72,970.

A-2092

ENGINEERING EXPERIMENT STATION
GEORGIA INSTITUTE OF TECHNOLOGY • ATLANTA, GEORGIA 30332

December 18, 1979

Harry A. Smith, Project Engineer NCHRP
Transportation Research Board
2101 Constitution Avenue
Washington, D. C. 20418

Re: Eighth Quarterly Progress Report for December 31, 1979, NCHRP 4-14, FY '78, "Coating Systems for Painting Old and New Structural Steel" Georgia Tech Project A-2092

Dear Harry:

It had become apparent just before I phoned you last week that we would not be able to finish our preliminary draft report in time before the Georgia Tech staff goes on an 11 day leave. Let's hope your associates and members of the panel are as understanding as you.

We will try to get in another panel inspection at Brunswick over the holidays.

As you will note in the attached report we have now spent all of our funds except about $1700.

Thank you for your cooperation, and best wishes for the holidays.

Sincerely,

Frank A. Rideout
Principal Investigator

FAR:gp

Attachment - 45 copies

QUARTERLY PROGRESS REPORT

to the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

on Project

NCHRP 4-14 FY'78

Coating Systems For Painting Old and New Structural Steel

for period

October 1, 1979 to December 31, 1979

from

Frank A. Rideout, Principal Investigator

Chemical and Material Sciences Laboratory
Georgia Institute of Technology
Engineering Experiment Station
Atlanta, Georgia 30332

TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

ct No. 4-14: COATING SYSTEMS FOR STRUCTURAL STEEL Fy' 78 Month Dec. '79
ncy Georgia Tech Research Institute (Engineering Experiment Station)
igator Frank A. Rideout, Acting Principal Investigator

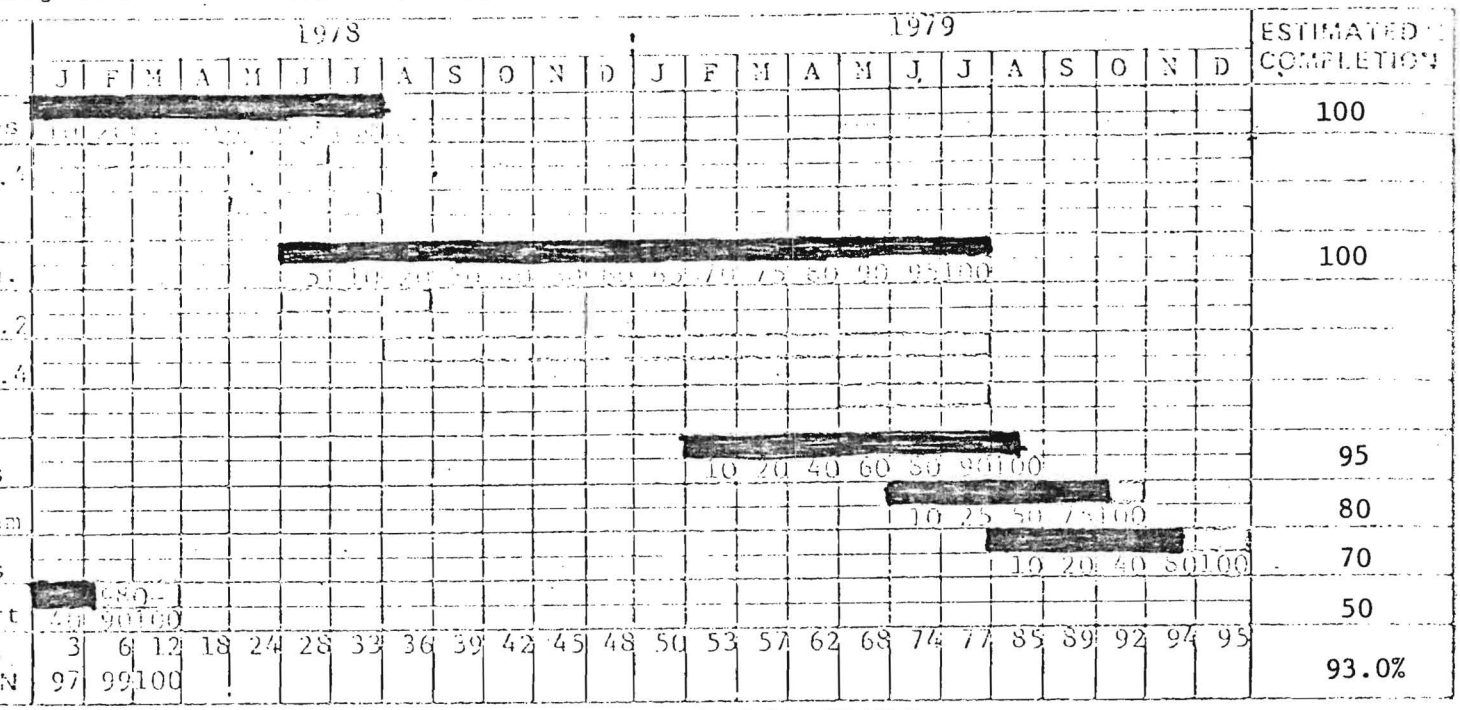


FIG. A–OVERALL PROJECT SCHEDULE

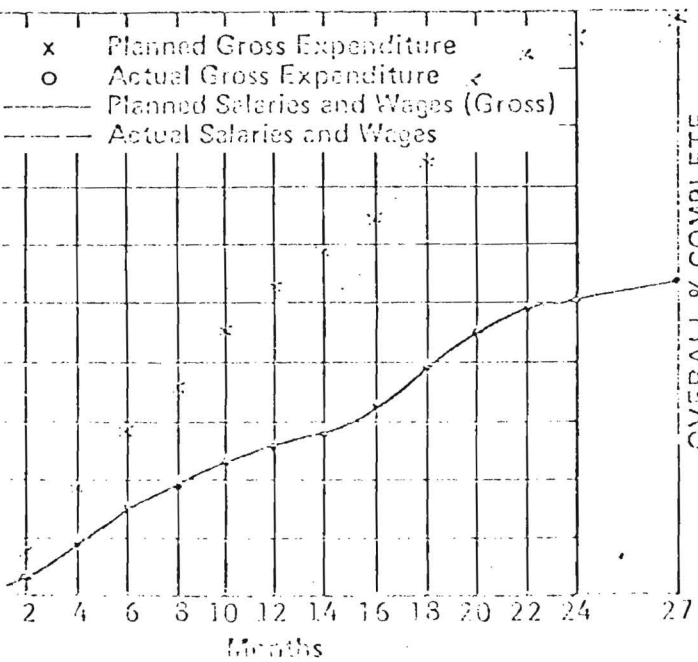


FIG. B CONTRACT FUNDS

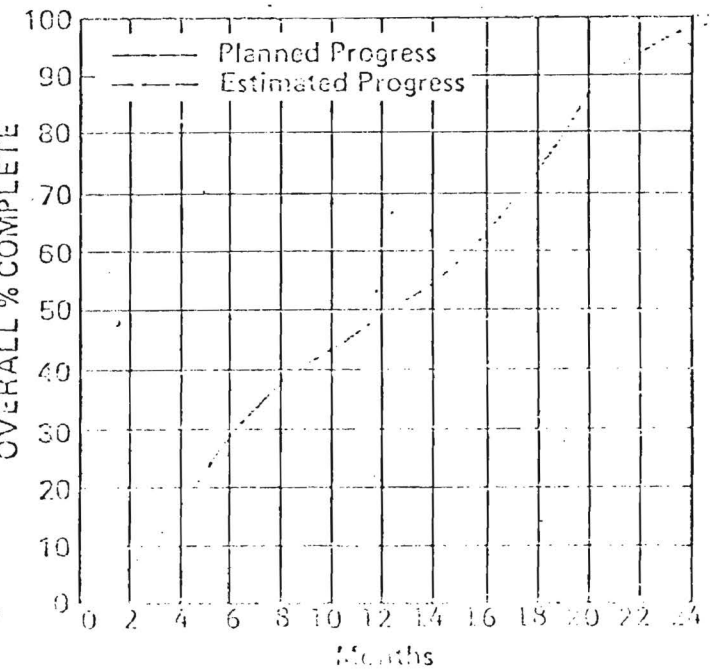


FIG. C CONTRACT PERIOD

Funds Expended	%	98.8	
Contract Amount	$	149,231.	
Expended this Month	$	4,397.	
Tot. Exp. To Date	$	147,511.	
Balance	$	1,720.	

Time Expended %		94.3
Starting Date		January 1, 1978
Completion Date		March 31, 1980

Salaries & Wages Estimated This Month	$	2,880.
Salaries & Wages Spent This Month	$	2,198.
Accumulated Salaries & Wages To Date	$	73,106.

EIGHTH QUARTERLY PROGRESS REPORT TO NCHRP DECEMBER 31, 1979

Project 4-14 FY'78

COATING SYSTEMS FOR PAINTING OLD AND NEW STRUCTURAL STEEL

Georgia Tech Project A-2092

I. Objective

The objective is the preparation of guidelines for the use of existing and recently developed non-proprietary coating systems for the painting of structural steel with emphasis on such considerations as:

(a) health and environment

(b) exposure conditions

(c) application requirements

(d) economics

II. Progress Toward Completion

The laboratory testing and panel evaluation is complete for the time assigned. The original KTA panels were put out at Brunswick February 1979 and the most recent evaluation was made on Nov. 21 (9 months). These panels showed premature failure in the channel welds due to insufficient paint in the depressions, so the second set was prepared and exposed June 21, 1979 (now 5 months old).

The old steel panels were exposed at Brunswick March 19, 1979 and in Atlanta, March 21. The last evaluation was after 8 months and 9 months respectively. Our plan called for at least 12 months exterior weathering. None of the systems could be judged failed at this point. Our draft of the final report will show rust beginning at pinholes and edges for initial comparisons, which will give some basis for comparing systems. The worst

rating is a "7", meaning that rust or rust spots covered about 5% of the panel.

We have requested the funds to continue to monitor the paint performance both at Brunswick and on Georgia Tech campus.

The preliminary final report is due this month in Washington but our best present estimate for shipping 20 copies is January 31, 1980. The delay is due to (1) one of the author's being out this month for an unexpected operation, (2) analysis and writing is taking longer than expected, and (3) all of Georgia Tech staff has 11 days leave starting December 21. We are sorry for any inconvenience which may result.

III. Progress by Phase

Phase I. Current Practices

Replies to our questionnaire have now been received from all 50 states and the tabulation shown in previous Quarterly Progress Reports is being rearranged and completed for the final report.

Phase II. Experimental Evaluation of Recently Developed Systems

The coating thicknesses chosen for the marine test site were less than guidelines recommend but such that performance variables would probably be evident in about one year. The nominal thicknesses chosen were 4 and 7 mils compared to 10 mils usually specified for moderate to severe marine exposure. The 8 and 9 months exposure is hardly enough to draw conclusions except that the beginning of rust spots is consistent with other data and experience.

Phase III. Tentative Guidelines

Based on the three zones reported in common usage in our last quarterly report we are suggesting surface preparation, generic type and thickness. Refinishing is reviewed with the thesis that usually the best recoat is the same type of vehicle as was used before as long as any of the previous paint remains to be topcoated.

Phase IV. Design of a Field Evaluation Program

The program we have to suggest is similar to that now practiced in Florida.

Phase V. Research Priorities

Waterborne systems (including paints containing portland cement) need more study especially the impact on surface preparations which may have gotten off on the wrong foot in some locations. We recommend the most careful surface preparation.

H-2092

QUARTERLY PROGRESS REPORT

to the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

on Project

NCHRP 4-14

COATING SYSTEMS FOR PAINTING OLD AND NEW STRUCTURAL STEEL

for period

April 1, 1981 to June 30, 1981

from

Engineering Experiment Station, Georgia Institute of Technology

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

roject No. 4-14 Coating Systems for Painting Old & New Structural Fy 78 Month June '81
Agency Georgia Tech Research Institute (Engineering Experiment Station)
nvestigator Charles J. Ray

CH	1978/1980 J	F	M	A	M	J	J	A	S	O	N	D	1979/1981 J	F	M	A	M	J	J	A	S	O	N	D	ESTIMATED % COMPLETION
nt ices	10	20	40	60	80	90	100	1978																	100
.1-4																									
.5																									
1 Eval.						Start 1978												End 1981							100
2.1-2.2																									
3 - 4																									
.5																									
elines														Start 1979							End 1981				25
d Program																		Start 1979			End 1981				20
rities																				St. 1979	End 1981				25
Report																									50
% TION																									85

FIG. A—OVERALL PROJECT SCHEDULE

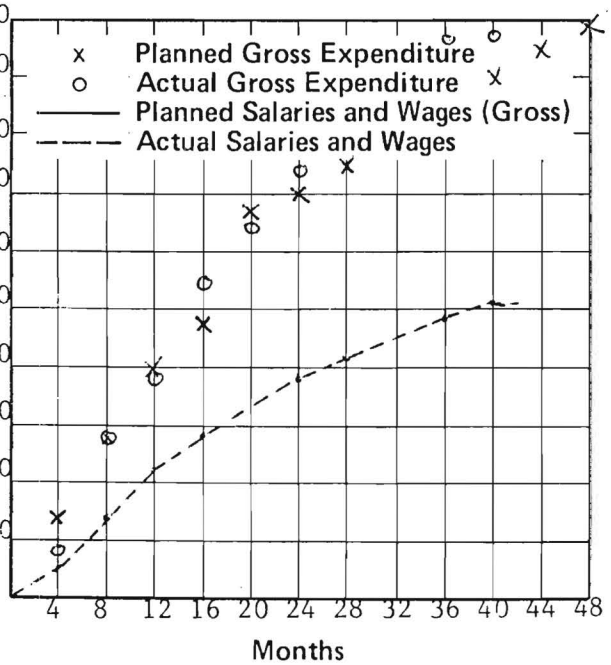


FIG. B—CONTRACT FUNDS

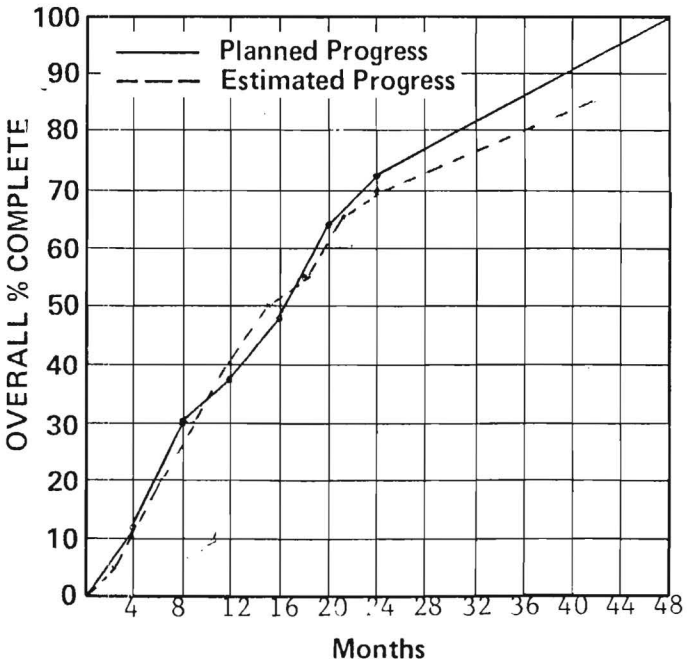


FIG. C—CONTRACT PERIOD

Funds Expended	%	99.5
Contract Amount	$	199,231
Expended this Month	$	0
Total Exp. To Date	$	198,301
Balance	$	930

Time Expended %		87.5
Starting Date		January 1, 1978
Completion Date		December 31, 1981

Salaries and Wages Estimated This Month	$	0
Salaries and Wages Spent This Month	$	0
Accumulated Salaries and Wages To Date	$	102,117

Quarterly Progress Report
April 1, 1981 - June 30, 1981

NCHRP 4-14 COATING SYSTEMS FOR PAINTING OLD AND NEW STRUCTURAL STEEL

1.0 Objective

The objective is the preparation of guidelines for the use of existing and recently developed, non-proprietary coating systems for painting bridge structural steel with emphasis on considerations of health and environment, exposure conditions, application requirements, and economics.

2.0 Progress

2.1 Phase I - Current Practice

The replies from the fifty states concerning their current painting practices, the impact of current and impending health and environment regulations on these practices, and their judgement as to research needs in painting bridges have been assembled. The draft of the review and analysis of these replies for the final report is being revised.

2.2 Phase II - Experimental evaluation of Recently developed Systems

The second set of KTA panels exposed at the Brunswick, Georgia test fence site now has two years of exposure. The original set has twenty-nine months of exposure. The steel panels on which test coatings were applied over either old, intact paint or rusty surfaces have a total exposure duration now of twenty-seven months.

The effect of these exposures on the durability of the coatings tested will be tabulated in the final report. They will also be analyzed in terms of the accelerated, laboratory test results and results for similar systems reported in the technical literature.

The initial draft of an appendix to the final report describing the experimental program and the exposure results has been revised. The latest exposure data remains to be incorporated.

2.3 Phase III - Tentative Guidelines

The preliminary draft of the guidelines has been reviewed critically in-house. Revisions are needed which will be made in the drafting of the final report.

2.4 Phase IV - Design of a Field Evaluation Program

Designs so far have not been developed in detail. This will be done in the preparation of the final report.

2.5 Phase V - Research Priorities

The research priorities have not been finalized. This must wait for the final report draft and an analysis of it in toto.

3.0 Future Work for Next Quarter

Prepare draft of final report and submit it to the review panel and TRB.

#-2092

QUARTERLY PROGRESS REPORT

to the

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

on Project

NCHRP 4-14

COATING SYSTEMS FOR PAINTING OLD AND NEW STRUCTURAL STEEL

for period

July 1, 1981 to September 30, 1981

from

Engineering Experiment Station, Georgia Institute of Technology

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

ject No. 4-14 Coating Systems for Painting Old & New Structural Fy 78 Month August 81.
ency Georgia Tech Research Institute (Engineering Experiment Station)
estigator Charles J. Ray

	1978/1980 J	F	M	A	M	J	J	A	S	O	N	D	1979/1981 J	F	M	A	M	J	J	A	S	O	N	D	ESTIMATED % COMPLETION
es	10	20	40	60	80	90	100	1978																	100
1-4																									
5																									
Eval.						Start 1978												End 1981							100
1-2																									
ines														Start 1979							End 1981				35
Program																		Start 1979			End 1981				35
ties																				St. 1979	End 1981				35
port																									70
% ON																									90

FIG. A—OVERALL PROJECT SCHEDULE

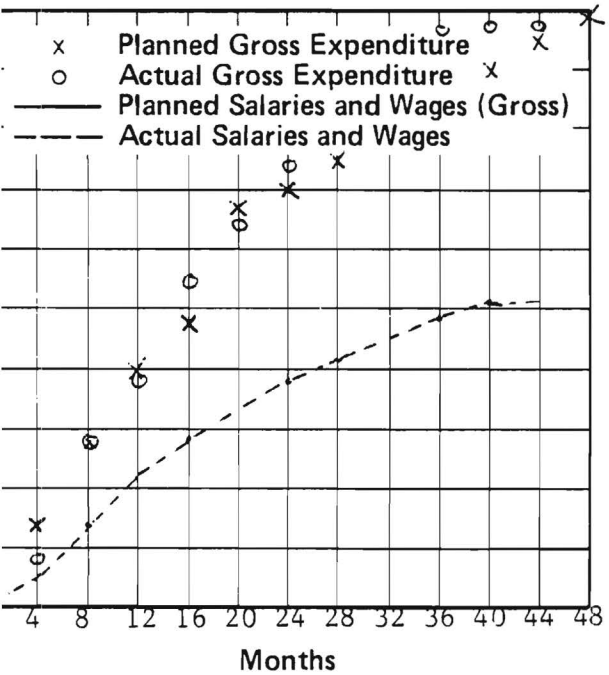


FIG. B—CONTRACT FUNDS

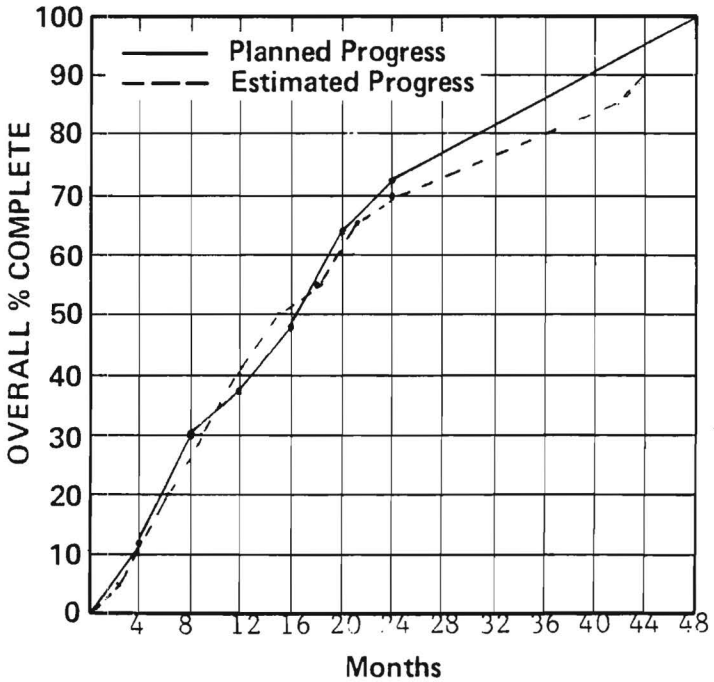


FIG. C—CONTRACT PERIOD

Funds Expended	%	99.5
Contract Amount	$	199,231
Expended this Month	$	0
Total Exp. To Date	$	198,302
Balance	$	929

Time Expended %		94
Starting Date		January 1, 1978
Completion Date		December 31, 1981

Salaries and Wages Estimated This Month	$	0
Salaries and Wages Spent This Month	$	0
Accumulated Salaries and Wages To Date	$	

Quarterly Progress Report

July 1, 1981 - September 30, 1981

NCHRP 4-14 Coating Systems for Painting Old and New Structural Steel

1.0 Objective

The objective is the preparation of guidelines for the use of existing and recently developed, non-proprietary coating systems for painting bridge structural steel with emphasis on considerations of health and environment, exposure conditions, application requirements, a nd economics.

2.0 Progress

2.1 Phase I - Current Practice

The original draft of the review and anlysis of replies from state DOT's concerning current practice in painting and maintaining highway bridges still needs to be revised.

2.2 Phase II - Experimental Evaluation of Recently Developed Systems

The description, analysis, and review of the performance data generated has been completed.

In general, the extent of paint system degradation observed in salt fog chamber testing is greater than that seen as a result of exposure to a marine atmosphere. The exposure times are approximately 3000 hours and 2 years, respectively.

2.3 Phase III - Tentative Guidelines

The guidelines are being written to cover three general cases of restraints on selection of a protective coating system. One restraint deals with the use of corrosion inhibiting pigments other than lead and chromate types. The second category addresses the options when blast cleaning to remove old paint containing lead or chromate bearing pigments is restricted. The third category involves economic considerations only, i.e., no restrictions on materials and processes.

2.4 Phase IV - Design of a Field Evaluation Program

Based on the lack of a national, solvent emissions standard for architectural paints, the emphasis of the field evaluation program will be an alternative corrosion inhibiting pigments to lead and chromate ones. This will reduce the number of waterborne systems to be included.

2.5 Phase V - Research Priorities

The research priorities have not been finalized.

3.0 Future Work for Next Quarter

Submit draft of the final report.

HR-2092

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

PROGRESS SCHEDULE

Project No. 4-14 Coating Systems for Painting Old & New Structural Fy 78 Month June '81
Agency Georgia Tech Research Institute (Engineering Experiment Station)
Investigator Charles J. Ray

RCH	1978/1980 J	F	M	A	M	J	J	A	S	O	N	D	1979/1981 J	F	M	A	M	J	J	A	S	O	N	D	ESTIMATED % COMPLETION
ent tices	10	20	40	60	80	90	100	1978																	100
1.1-1.4																									
1.5																									
t'l Eval.						Start 1978												End 1981							100
2.1-2.2																									
.3 - .4																									
2.5																									
delines														Start 1979							End 1981				25
ld Program																	Start 1979				End 1981				20
orities																				St. 1979	End 1981				25
Report																									60
LL % ETION																									87

FIG. A—OVERALL PROJECT SCHEDULE

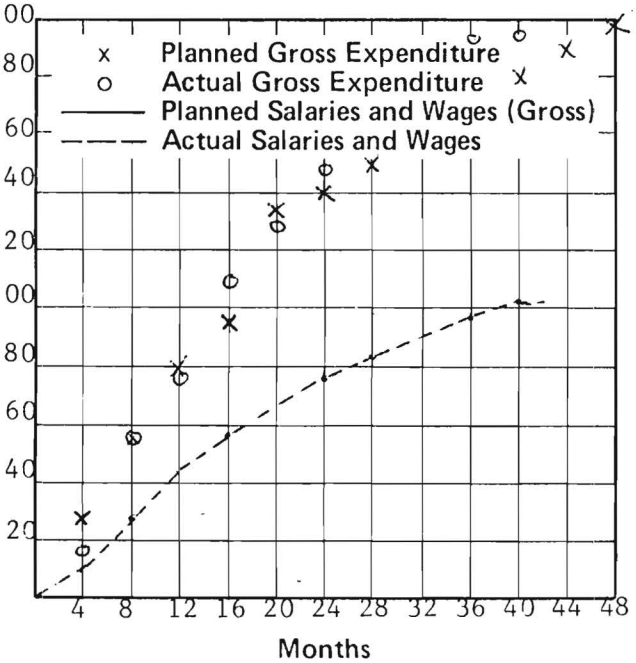


FIG. B—CONTRACT FUNDS

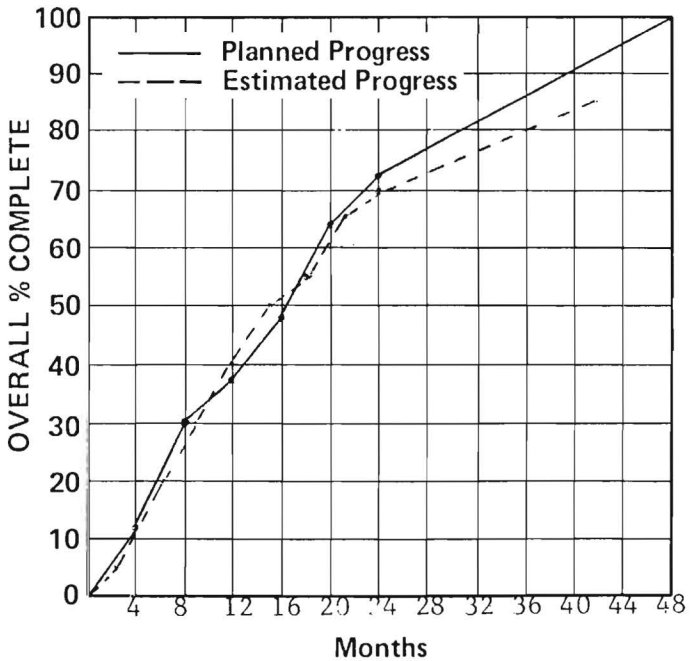


FIG. C—CONTRACT PERIOD

Funds Expended	%	99.5
Contract Amount	$	199,231
Expended this Month	$	0
Total Exp. To Date	$	198,302
Balance	$	929

Time Expended %		89.6
Starting Date		January 1, 1978
Completion Date		December 31, 1981

Salaries and Wages Estimated This Month	$	0
Salaries and Wages Spent This Month	$	0
Accumulated Salaries and Wages To Date	$	102,117

NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM
TRANSPORTATION RESEARCH BOARD
NATIONAL RESEARCH COUNCIL

H-2092

PROGRESS SCHEDULE

Project No. 4-14 Coating Systems for Painting Old & New Structural Fy 78 Month August 81.
Agency Georgia Tech Research Institute (Engineering Experiment Station)
Investigator Charles J. Ray

RCH S	1978/1980 J F M A M J J A S O N D	1979/1981 J F M A M J J A S O N D	ESTIMATED % COMPLETION
ent tices	10 20 40 60 80 90 100 1978		100
1.1-1.4			
1.5			
t'l Eval.	Start 1978	End 1981	100
2.1-2.2			
2.3 - 2.4			
2.5			
idelines		Start 1979 End 1981	25
eld Program		Start 1979 End 1981	20
orities		St. 1979 End 1981	25
Report			60
LL % ETION			87

FIG. A—OVERALL PROJECT SCHEDULE

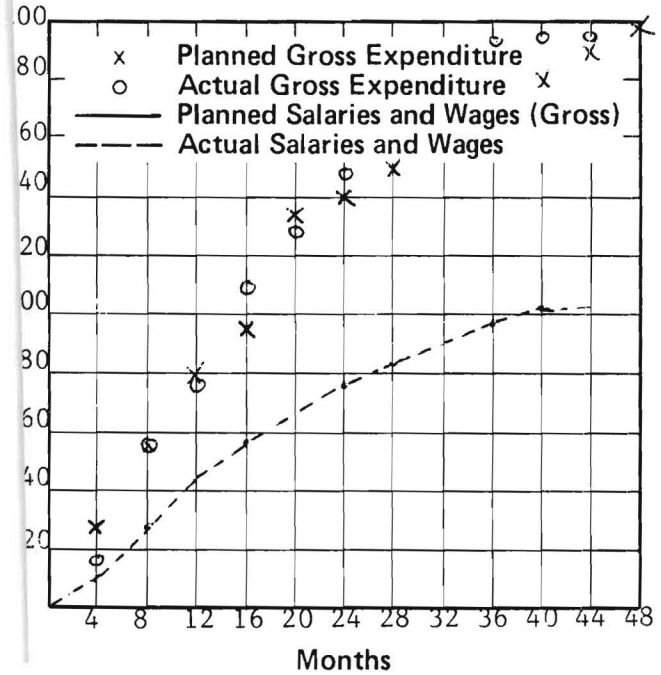
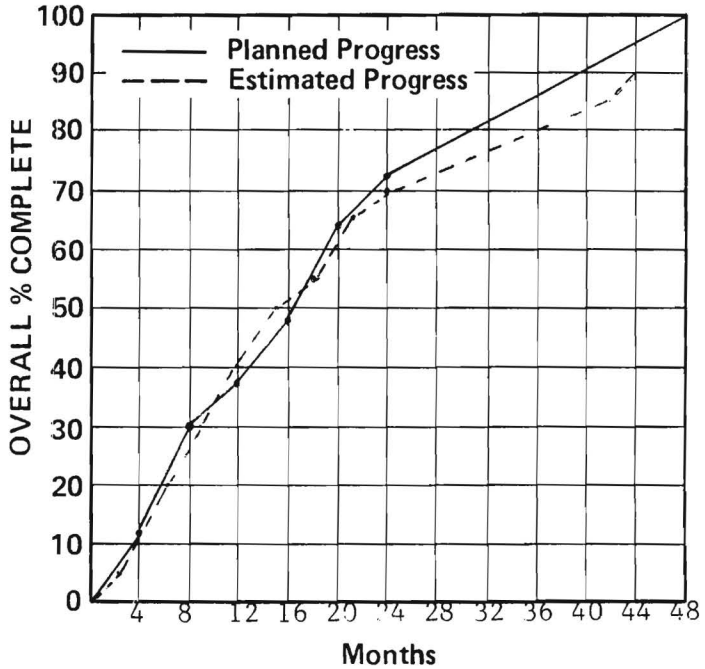


FIG. B—CONTRACT FUNDS



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